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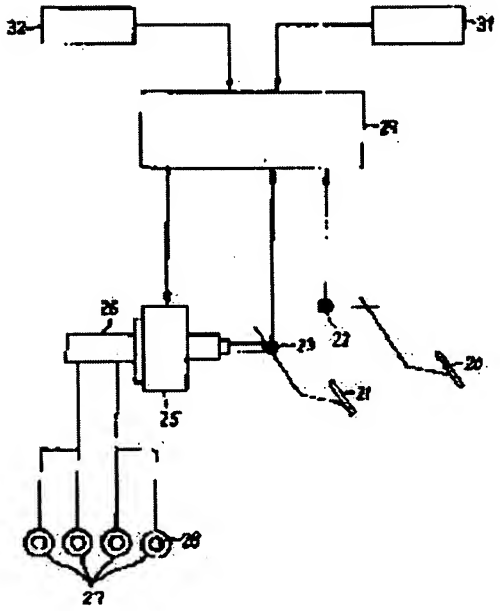
## (54) BRAKE ASSIST SYSTEM

(57)Abstract:

PROBLEM TO BE SOLVED: To perform a brake assisting function appropriately by applying a brake pressure higher than that generated through depression of the brake pedal operated by a driver in response to the determination that the driver's vehicle is approaching the vehicle running ahead too close based on the distance between those vehicles less than the threshold value.




SOLUTION: A control unit 29 detects the headway distance between the running vehicle and the object existing in front thereof and detects the speed of the running vehicle, which can be used to calculate the relative speed. Based on the relative speed, the braking distance is calculated. A threshold value is obtained by adding the allowance distance and the calculated braking distance. If the present headway distance is less than the threshold value, it is determined that the vehicle has been approaching the object ahead too close. Then, the control is executed to drive the solenoid valve of the negative booster 25 such that the braking pressure higher than that generated through depression of the brake pedal by the driver. As a result, the brake assist control can be appropriately performed.

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## CLAIMS

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[Claim(s)]
[Claim 1] The brake assistant system characterized by providing the following. A means to detect distance with the front detection object of self-vehicles. A means to detect the car body speed of a self-vehicle. A means to calculate relative velocity from this front distance and this self-vehicle speed. A means to calculate a brake stopping distance from this relative velocity, a means to compute the buffer distance added to this brake stopping distance, the means that makes a threshold the sum of the brake stopping distance and buffer distance which were computed, a means to judge that it approaches too much when the present distance between two cars is less from a threshold, and a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as ****.
[Claim 2] The brake assistant system according to claim 1 characterized by what the threshold of the distance between two cars which balanced the property of the operator concerned by supervising one or more [ of how to take ** dull operation of an operator, vehicles information including braking deceleration, and the distance between two cars, when computing a buffer distance from the self-vehicle speed ] is set up for.
[Claim 3] The brake assistant system characterized by what a float is determined for in a claim 1 or a claim 2 according to this mean time including a means to compute a mean time, at least from the history of the foot transfer time from an accelerator pedal to a brake pedal.
[Claim 4] The brake assistant system characterized by what a float is determined for from the history of the distance between two cars in a claim 1 or a claim 2 according to this distance-between-two-cars average including a means to compute the distance-between-two-cars average, at least.
[Claim 5] The brake assistant system characterized by what a float is determined for from the history of the vehicles order deceleration under braking in a claim 1 or a claim 2 according to this average braking deceleration including a means to compute average braking deceleration, at least.
[Claim 6] The brake assistant system characterized by what it has further a means to compute a mean time from the history of the foot transfer time from an accelerator pedal to a brake pedal, a means to compute the distance average between history empty vehicles of the distance between two cars, and a means to compute average braking deceleration from the history of the vehicles order deceleration under braking, in a claim 1 or a claim 2, and a buffer distance is determined for according to the size of three physical quantity, these mean times, the distance-between-two-cars average, and average braking deceleration.
[Claim 7] It is the brake assistant system characterized by what the value of a buffer distance is set up for sufficiently more greatly than usual in a claim 6 when [ when the foot-transfer-time average is large, and the distance-between-two-cars average is small ] average braking deceleration is small.
[Claim 8] It is the brake assistant system characterized by what the value of a buffer distance is set up for sufficiently smaller than usual in a claim 6 when [ when the foot-transfer-time average is small, and the distance-between-two-cars average is large ] average braking deceleration is large.
[Claim 9] The historical data to which foot transfer time exceeds a predetermined time in either a claim

3, a claim 6, a claim 7 or the claim 8 are a brake assistant system characterized by what is excepted from calculation of a mean time.
[Claim 10] The brake assistant system characterized by what a buffer distance is determined for in either a claim 1 or the claim 9 from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed.
[Claim 11] The brake assistant system characterized by what the distance between two cars / vehicle speed or the vehicle speed / distance between two cars is used for instead of the distribution of the distance between two cars in a claim 10.
[Claim 12] The brake assistant system characterized by what vehicles deceleration when time for the vehicles deceleration under brake treading in to be within the limits of predetermined carries out predetermined-time progress in either a claim 5, a claim 6, a claim 7 or the claim 8 is used for calculation of the average for.
[Claim 13] A brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as **** in either a claim 1 or the claim 12 is a brake assistant system characterized by what fluid-pressure gain over the brake input by the operator is made high for.
[Claim 14] The brake assistant system characterized by what the value of this threshold is made small for when it had further a means to give a predetermined pressure when an operator's brake input speed was detected and input speed exceeded rather than a threshold in either a claim 1 or the claim 12, and approaches and is judged as ****.
[Claim 15] The brake assistant system characterized by what the value of the pressure to give is enlarged for when it had further a means to give a predetermined pressure when an operator's brake input speed was detected and input speed exceeded rather than a threshold in either a claim 1 or the claim 12, and approaches and is judged as ****.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to the brake assistant system of vehicles.
[0002]
[Description of the Prior Art] As a brake assistant system, there are some which were indicated by JP,4-25182,B (reference 1). when distance with a front obstruction is less than a safety distance, while carrying out the alarm of the risk to an operator by reference 1 -- brake ** -- the attempt which carries out auxiliary braking of the brake pressure at the time of dull treading in is proposed
[0003]
[Problem(s) to be Solved by the Invention] A brake assistant system can expect that a stopping distance is shortened and an effect can be demonstrated at safety at improvement, if an operator [ brakes operation ] can be assisted in the scene where the operation of this system -- a forward vehicle carries out a quick stop -- should be needed. On the other hand, if its attention is paid to the operation pattern of the operator who will be assisted, it is various by a skillful grade, skillful age, etc. Moreover, even if, even if it is the operator of the same age and a skillful degree, it may become various also according to the difference of vehicles operation of an individual. When carrying out a deer and defining the threshold of the above-mentioned safety distance uniquely, the following points (problem) can be pointed out.
[0004] (b) Since an operator's operation pattern was not concerned variously but the threshold of a safety distance is defined uniquely, if a threshold is set up according to the property of the operator who maintains the average distance between two cars, since the above-mentioned auxiliary braking is started frequently, for an operator with the feature which packs and runs the distance between two cars, the aggravation of a feeling depended for being effective too much may be caused.
[0005] (b) If the distance between two cars sets a threshold to a small side on the contrary, for the operator who vacates and runs the distance between two cars, the opportunity of auxiliary braking will decrease and the effect of a system will fade.
[0006] Therefore, it is desirable as a brake assistant system to be also able to raise the correspondence nature from such a viewpoint, to demonstrate the function of original of brake assistant control appropriately the neither more nor less, and to make it get. Moreover, it is more desirable by enabling it to monitor how to take pedal operation of an operator, vehicles information (braking G), and the distance between two cars continuously that the situation that the system concerned should be operated exactly can be detected and brake assistance can be carried out by grasping the peculiarity of the operator concerned and setting up the threshold of the distance between two cars corresponding to the operator's property.
[0007] this invention will realize the brake assistant system in which is going to add an improvement from these points also based on the consideration described also below based on the above considerations, can also raise the correspondence nature from a viewpoint mentioned above, and excess

and deficiency do not have, either, is made to demonstrate the function of brake assistant control original appropriately, and it deals. Moreover, a brake assistant system will be offered by supervising one or more [ of how to take ** dull operation of an operator, braking deceleration, and the distance between two cars ] at least, and grasping the peculiarity of the operator concerned.
[0008]
[Means for Solving the Problem] The following brake assistant system is offered by this invention. Namely, the brake assistant system of this invention A means to detect distance with the front detection object of self-vehicles, and a means to detect the car body speed of a self-vehicle, A means to calculate relative velocity from this front distance and this self-vehicle speed, and a means to calculate a brake stopping distance from this relative velocity, A means to compute the buffer distance added to this brake stopping distance, and the means which makes a threshold the sum of the brake stopping distance and buffer distance which were computed, It is characterized by having a means to judge that it approaches too much when the present distance between two cars is less from a threshold, and a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as ****.
[0009] Moreover, when computing a buffer distance from the self-vehicle speed, it is characterized by what the threshold of the distance between two cars corresponding to the property of the operator concerned is set up for by supervising one or more [ of how to take ** dull operation of an operator, vehicles information including braking deceleration, and the distance between two cars ].
[0010] Moreover, it is characterized by what a float is determined for according to this mean time including a means to compute a mean time, at least from the history of the foot transfer time from an accelerator pedal to a brake pedal.
[0011] Moreover, it is characterized by what a float is determined for from the history of the distance between two cars according to this distance-between-two-cars average including a means to compute the distance-between-two-cars average, at least.
[0012] Moreover, it is characterized by what a float is determined for from the history of the vehicles order deceleration under braking according to this average braking deceleration including a means to compute average braking deceleration, at least.
[0013] Moreover, it has further a means to compute a mean time from the history of the foot transfer time from an accelerator pedal to a brake pedal, a means to compute the distance average between history empty vehicles of the distance between two cars, and a means to compute average braking deceleration from the history of the vehicles order deceleration under braking, and is characterized by what a buffer distance is determined for according to the size of three physical quantity, these mean times, the distance-between-two-cars average, and average braking deceleration.
[0014] Moreover, small [ the distance-between-two-cars average ], when average braking deceleration is small, it is characterized by what the value of a buffer distance is set up for sufficiently more greatly than usual greatly [ the foot-transfer-time average ].
[0015] Moreover, greatly [ the distance-between-two-cars average ], when average braking deceleration is large, it is characterized by what the value of a buffer distance is set up for sufficiently smaller than usual small [ the foot-transfer-time average ].
[0016] Moreover, the historical data to which foot transfer time exceeds a predetermined time are characterized by what is excepted from calculation of a mean time.
[0017] Moreover, it is characterized by what a buffer distance is determined for from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed.
[0018] Moreover, it is characterized by what the distance between two cars / vehicle speed or the vehicle speed / distance between two cars is used for instead of the distribution of the distance between two cars.

[0019] Moreover, it is characterized by what vehicles deceleration when time for the vehicles deceleration under brake treading in to be within the limits of predetermined carries out predetermined-time progress is used for calculation of the average for.

[0020] Moreover, a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as **** is characterized by what fluid-pressure gain over the brake input by the operator is made high for.
[0021] Moreover, an operator's brake input speed is detected, and when it had further a means to give a predetermined pressure when input speed exceeded rather than a threshold, and approaches and is judged as ****, it is characterized by what the value of this threshold is made small for.
[0022] Moreover, an operator's brake input speed is detected, and when it had further a means to give a predetermined pressure when input speed exceeded rather than a threshold, and approaches and is judged as ****, it is characterized by what the value of the pressure to give is enlarged for.
[0023]
[Effect of the Invention] While according to this invention having each of each means according to claim 1 and being able to make brake assistant control perform by the above-mentioned composition at the time of an operator's brakes operation, if possible, it closes easily determining and setting up the buffer distance appropriately, as an adjustable controlled variable applied to the calculation brake stopping distance, this brake assistance being carried out and cheating from a viewpoint of the above-mentioned consideration matter as the neither more nor less effective thing. Depending on therefore, the composition which defines the threshold of a safety distance uniquely although an operator's operation pattern is various The place where the aggravation of a feeling depended for being effective too much is caused at although it will go into brake assistance frequently therefore, or the effect of original of a system fades in this invention Such a situation can be avoided, the threshold corresponding to an operator's property can be set up, correspondence nature is raised, there are also no excess and deficiency, and it becomes possible to realize the improved brake assistant system in which is made to demonstrate the function of brake assistant control appropriately, and it deals.
[0024] A threshold setup can be performed here according to either or all the elements of how to take ** dull operation of the operator, braking deceleration, and the distance between two cars, if the threshold is set up like according to claim 2. Therefore, by grasping the peculiarity of the operator concerned by this The threshold of the distance between two cars corresponding to the property of the part and the operator concerned can be set up the more nearly optimal. The state where passing approaches exactly is detected, and for the operator concerned, in view of the operator's property, a system can carry out brake assistance and if possible, it closes making it become what has brake assistance more suitable for the operator concerned.
[0025] in this case, about the buffer distance applied to be added to the brake stopping distance For example, it has each calculation means at least like claim 3 or claim 5 publication. In the mode which determines a float according to this mean time from a means to compute a mean time, from the history of the foot transfer time from an accelerator pedal to a brake pedal In or the mode which determines a float from the history of the distance between two cars according to this distance-between-two-cars average from a means to compute the distance-between-two-cars average Or as composition by one of the modes of the mode which determines a float from the history of the vehicles order deceleration under braking according to this average braking deceleration from a means to compute average braking deceleration, this invention can be carried out suitably and can realize the above-mentioned thing similarly. Furthermore, as a result of the thing of a state with few the biass about whether can ask for the average corresponding thing from the history of the element with which the past corresponds in these cases, and can grasp the peculiarity of the part and its operator appropriately and certainly, for example, the operator concerned is running with the distance between two cars of how much usually is obtained and being reflected this in a setup of a buffer distance, the threshold which balanced the operator's property and the feature more effectively can set up.
[0026] Moreover, as composition according to claim 6 which determines a buffer distance like according to the size of all three physical quantity, the mean time of these foot transfer time, the distance-between-two-cars average, and average braking deceleration, this invention can be carried out suitably and can realize the above-mentioned thing similarly preferably. In addition, it is possible by monitoring all of how to take ** dull operation of the operator, braking deceleration, and the distance

between two cars in this case continuously to make the operator's peculiarity grasp more appropriately and certainly. Therefore, in a setup of a buffer distance, and determination, this can be performed more finely, the feature of the operator concerned can be correctly presumed from all the field of them for the average about the foot transfer time, the distance-between-two-cars average, and any element of average braking deceleration, and the optimal buffer distance, therefore the optimal threshold can be set up. Also for an operator with the feature vacates the distance between two cars conversely also for the operator who has the feature which packs and runs the distance between two cars again, and it runs, therefore, further Also for each operator who has the feature separately depending on how to apply pedal operation and braking from skillful degree age etc. It has correspondence nature it is large, possible correspondence and high also to these operators, and the above-mentioned effect of demonstrating the function of brake assistant control original appropriately the neither more nor less can be pulled out further. about the threshold concerned, if it approaches more than this, as an approach threshold of being less than a safety distance, it may be set up as a value which consists of the sum of the stopping distance which is physically rich, and the buffer distance concerning cognition and ****, and the function will be achieved well here -- it becomes

[0027] Moreover, when determining a buffer distance according to the size of the foot-transfer-time average, the distance-between-two-cars average, and the physical quantity of average braking deceleration, this invention can be suitably carried out in like and the mode which sets up the value of the buffer distance according to claim 7 or 8. In this case, it should respond to the foot-transfer-time average, the distance-between-two-cars average, and the combination of the size of three physical quantity of average braking deceleration by doing in this way. therefore -- for example, the combination of this size -- as an operator's feature -- a maximum of eight sorts of things -- a case -- a division -- possible -- it -- doubling -- the above-mentioned addition -- the value of the buffer distance which should be carried out can be assigned According to the suitable example, the value of a buffer distance can set this up like the value of a degree, a big value, and a bigger value a for example more small value, a small value, and middle, and can be set up that much finely. But this invention is not restricted to the method of setting up a buffer distance gradually in this way, and can be carried out also by the method of calculating the value of a synthetic buffer distance, by using these three physical quantity as reference data using the table and map which made property data memorize beforehand.

[0028] Moreover, when this invention computes the mean time from the history of the foot transfer time from an accelerator pedal to a brake pedal, the historical data according to claim 9 to which foot transfer time exceeds a predetermined time can be suitably carried out from calculation of a mean time like as composition to except. thus -- if it carries out -- the above-mentioned effect -- in addition, a series of ** dull operations of having released an accelerator pedal even if and breaking in brake ** DARU after that were performed -- an imitation -- Although the historical data exceeding such a predetermined time can be excepted from calculation of the mean time of foot transfer time, can do foot-transfer-time information in case foot transfer time is less than a predetermined time chiefly with an object and a buffer distance is defined It will become more exact, precision can be raised and rationalization of this brake assistant control can be attained. Moreover, it is not necessary to make into an object foot transfer time at the time of the state of **** from an accelerator pedal with which the time which such **** takes also exceeds a predetermined time to a brake pedal also as historical data. Even when it is going to determine a buffer distance according to the foot-transfer-time average acquired from the history of the foot transfer time, also about the history of the part and the foot transfer time to apply, it will become more exact and improvement in precision can be aimed at.

[0029] Moreover, in this invention, it can consider as the composition according to claim 10 which determines a buffer distance like from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed. thus -- if it carries out -- the above-mentioned effect -- in addition, the information on the distance between two cars can be excepted by low-speed run state which is not filled with the time of a 1 fixed-speed run into the predetermined vehicle speed, the distance-between-two-cars information at the time of the 1 fixed-speed run more than the predetermined vehicle speed is chiefly made with an object, to defining a buffer distance, it will

become more exact, precision raises, and rationalization of this brake assistant control can attain to it Moreover, the distance between two cars at the time of such a low-speed run does not need to consider as an object as historical data, even when it is going to determine a buffer distance according to the distance-between-two-cars average acquired from the history of the distance between two cars, also about the history of the part and the distance between two cars to apply, will become more exact and can aim at improvement in precision. Moreover, in this case, it is good also as composition according to claim 11 which uses the distance between two cars / vehicle speed or the vehicle speed / distance between two cars instead of like and the distribution of the distance between two cars, and the above-mentioned thing can be realized similarly.

[0030] Moreover, this invention can be suitably carried out as composition [ like ] according to claim 12. In addition, vehicles deceleration when time for the vehicles deceleration under brake treading in to be within the limits of predetermined carries out predetermined-time progress chiefly can be used for calculation of the average. thus -- if it carries out -- the above-mentioned effect -- Can do the outside of an object except it and it will become more exact defining a buffer distance. Precision can be raised and rationalization of this brake assistant control can be attained. Moreover, it is not necessary to make vehicles deceleration in other than the above-mentioned condition into an object also as historical data. Even when it is going to determine a buffer distance according to the average braking deceleration obtained from the history of the deceleration of the vehicles under braking, also about the history of the part and the vehicles deceleration to apply, it will become more exact and improvement in precision can be aimed at.

[0031] Moreover, when [ according to claim 13 ] it approaches and is judged as **** like, it can carry out suitably as composition which makes high fluid-pressure gain over the brake input according this to an operator as a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation. in this case, in addition to the above-mentioned effect, at the time of brake assistance, the braking fluid pressure exceeding the brakes operation force more quickly can be started, assistant ** can be given, and it can respond to brake assistance appropriately, and may become effective at this point, and this invention may consider and carry out such control

[0032] Moreover, when it had a means to give a predetermined pressure when [ according to claim 14 ] an operator's brake input speed was detected and input speed exceeded rather than a threshold like, and approaches and is judged as ****, it can carry out as composition of the mode which makes the value of this threshold small. In this case, it is also preparing the threshold for comparison to an operator's brake input speed, and comparing the brake input speed detected with this. Are suitably [ in the case of the method which carries out brake assistance so that a predetermined pressure may be given, when the input speed exceeds rather than this threshold ] applicable. The distance between two cars approaching and being judged as **** is interlocked with, and the threshold for the comparison concerned is made small according to it. The judgment with the detection brake input speed can be performed, and this invention can also consider and carry out such control at the above times of a brake assistant method. Or it is [ like ] good again also as composition of the mode which enlarges the value of the pressure to give similarly when it has a means to give a predetermined pressure when [ according to claim 15 ] an operator's brake input speed is detected and input speed exceeds rather than a threshold, and the distance between two cars approaches and it is judged as ****. Also in this case, it can apply to the above-mentioned brake assistant method, and this invention can be carried out suitably.

[0033]

[Embodiments of the Invention] Hereafter, the form of operation of this invention is explained based on a drawing. Drawing 1 and 2 are drawings showing one example of this invention, and drawing 1 is the whole block diagram. 20 and 21 show the accelerator pedal which an operator (driver) operates, respectively, and a brake pedal among drawing 1 . Brake stroke SENSATO 23 which detects the control input of this brake pedal is formed in a brake pedal 21. In this example, the accelerator stroke sensor 22 which detects the control input of this accelerator pedal is formed in an accelerator pedal 20.

[0034] Moreover, in this example, it has the master cylinder (M/C) 26 which is interlocked with the brakes operation by the brake pedal 21, and is made to generate a brake fluid pressure, and while leading

the brake fluid pressure (damping force) which made it generate with this master cylinder to the wheel cylinder (W/C) of each wheel 27 of vehicles and making it make a brake act, a master cylinder 26 is equipped with the negative pressure booster 25 which contains the solenoid valve. Although the brake fluid pressure which answers the treading-in position of a brake pedal 21 is outputted at the time of treading in to the brake pedal 21 by the driver, when it corresponds like the after-mentioned, the master cylinder 26 which has this negative pressure booster 25 generates the damping force which can give brake pressure higher than the brake pressure generated by the brakes operation of a driver under the assistance by the negative pressure booster 25, therefore exceeds the operating physical force of a driver, and it deals in it.

[0035] Drawing 2 is the block diagram of a negative pressure booster, and, thereby, explains an example of the structure of the negative pressure booster 25 hereafter. The negative pressure booster 25 has a power piston 40, the transformation room 41 divided by the diaphram 54, and the negative pressure room 42. Here, the negative pressure room 42 was made to open for free passage here with the inlet pipe (throttle-valve lower stream of a river) of the engine which is not illustrated, for example, therefore predetermined negative pressure has always occurred during an engine drive at the negative pressure room 42. the tubed solenoid-valve linkage which a power piston 40 is equipped with the vacuum valve 43, a breather valve 44, and a solenoid valve 45, and is stroked by excitation of this solenoid valve to the left in drawing -- it has the operation rating rod 46 interlocked with a member 47 and brake ** dull operation Moreover, as shown in drawing 2 , return springs 53a and 53b, a diaphragm return spring 55, and spring 56 grade are incorporated.

[0036] The case where it will be in the same negative pressure state as the negative pressure room 42 through the negative pressure path 51 of a power piston 40, and in the case of the state of air opening, the transformation room 41 is switched. A change is performed by opening and closing of the vacuum valve 43 and a breather valve 44 (atmospheric pressure path section). A part for the valve portion by the side of the vacuum valve 43 which the opening part of the negative pressure path 51 counters with this like illustration like the state of drawing 2 (among drawing) It is in the state (vacuum valve-opening) where the up part of the tubed valve element which made return spring 53a intervene between the right end sections of a member 47 separates from it being considerable, and is opened wide. according to and the energization force of return springs 53a and 53b illustration -- like -- the above-mentioned solenoid-valve linkage -- the valve seat 52 of the breather valve 44 prepared in the member 47 in the state (breather-valve close) where sat down in the atmospheric pressure path section (the lower part in drawing of the above-mentioned tubed valve element is considerable) by the side of the atmosphere, and this is shut Negative pressure is led to the transformation room 41 from the negative pressure room 42, therefore, as for the transformation room 41, the negative pressure room 42 and the pressure balance in the state of negative pressure. Both loculus are in this state at the time of brake un-operating.

[0037] A deer is carried out, the atmosphere is introduced at the time of a brake operation, differential pressure with the negative pressure room 42 arises in the transformation room 41, and the load which doubled the power to the master cylinder 26 is transmitted to it. namely, brake ** -- dull -- the solenoid-valve linkage which supports return spring 53a in connection with the operation rating rod 46 being pushed in into a power piston 40 at the time of treading in of 21 -- if a member 47 moves only a predetermined stroke to the left in drawing to a power piston 40, according to the elastic stability of return spring 53a, the above-mentioned tubed valve element concerning the vacuum valve 43 and a breather valve 44 will ****, and it will come to close the negative pressure path 11 in the position [ begin ] which this negative pressure path 11 closes, the atmospheric pressure circulation space by the side of a breather valve 44 is still shut -- having -- **** -- from this position -- further -- solenoid-valve linkage -- solenoid-valve linkage if a member 47 ****, since the tubed valve element is unmovable any more in the state where it sat down to opening of the negative pressure path 11 -- the valve seat 52 of a member 47 will separate from the tubed valve element here, and an atmospheric pressure path will open (vacuum valve-closing and breather-valve open) Atmospheric pressure is led to the transformation room 41 by this, and differential pressure arises in the negative pressure room 42 and the transformation room 41.

[0038] if such a change is performed by control of a solenoid valve 45 and drive current is supplied to a solenoid valve 45 -- the electromagnetic force -- solenoid-valve linkage -- while a member 47 resists a spring 56, is attracted leftward in drawing and closes the negative pressure path 11, it can shift to the position which makes an atmospheric pressure path open wide, and the same function as the above can be made to perform Therefore, in this example, the vacuum valve 43 is closed, when a brake pedal 21 strokes by the driver, or when this solenoid valve 45 excites, and it intercepts a free passage with the negative pressure room 42 and the transformation room 41. Moreover, a breather valve 44 is opened, when a brake pedal 21 strokes by the driver, or when this solenoid valve 45 excites, and the atmosphere is introduced into the transformation room 41. therefore, the time of a solenoid valve 45 being excited to the corresponding timing, when carrying out drive control of the solenoid valve 45 -- solenoid-valve linkage -- a member 47 strokes leftward in drawing and switching operation of the vacuum valve 43 and a breather valve 44 is performed Differential pressure arises between the negative pressure room 42 and the transformation room 41 by that cause, the force gets across to the bush rod 48 and a master cylinder 26 through a reaction disc 49, and a brake force (braking fluid pressure) occurs to each wheel 27. Thus, the negative pressure booster 25 of drawing 2 can perform brake assistance.
[0039] It returns to drawing 1 , and a brake assistant means can be constituted including this negative pressure booster 25, and the solenoid valve 45 in the negative pressure booster 25 is controlled by this example with the control unit (controller) 29 which performs brake assistant control. The signal from the brake stroke sensor 23, each sensor 28 which detects the rotational speed of each wheel 27, and laser radar sensor which it is attached for example, in vehicles front front grill, and can be used for detection of vehicles distance with front vehicles 31 grade is inputted into this control unit 29. Moreover, the signal from the G sensor 32 when it corresponds, before and after measuring the degree of acceleration and deceleration of the accelerator stroke sensor 22 and vehicles can be inputted.
[0040] The control unit 29 into which the information before and behind [ G ] an accelerator stroke, a brake stroke, wheel rotational speed, the distance between two cars, and vehicles etc. is inputted is constituted including a microcomputer, and can consist of a store circuit which stores the control program for the brake assistance performed in an input detector, a data-processing circuit (CPU), and this data-processing circuit, other control programs, the result of an operation, etc., an output circuit which outputs the control signal which drives solenoid valves (RAM, ROM, etc.) 45.
[0041] Although a control unit 29 can perform brake assistant control fundamentally on the occasion of brake assistant control based on input, such as a brake stroke, according to the control program which shows the example to drawing 7 with a flow chart when it is judged that it is urgent Furthermore, while detecting distance with the front detection object of self-vehicles, to make [ neither more nor less from a viewpoint of the consideration matter (b) of the specification beginning, and a (b) ] this effective Detect the car body speed of a self-vehicle, calculate relative velocity from this front distance and this self-vehicle speed, calculate a brake stopping distance (X1) from this relative velocity, and a buffer distance (X2) is further applied to this. When made into the threshold the sum (X1+X2=Xsum) of the brake stopping distance (X1) and buffer distance (X2) which were computed, it approached when the present distance between two cars was less from a threshold (Xsum), and it is judged as ****, it approaches in this way and it is judged as **** Drive control to the solenoid valve 45 of the above-mentioned negative pressure booster 25 is performed so that brake pressure higher than the brake pressure generated by the brakes operation of a driver may be given.
[0042] In this case, the buffer distance (X2) introduced to be added to a brake stopping distance (X1) is an adjustable controlled variable, preferably, shall compute a buffer distance (X2) from the self-vehicle speed, and computes and determines a control unit 29 in one of modes again. That is, as a flow chart shows the example to drawing 3 , from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed (self-vehicle speed), a buffer distance (X2) is determined, or the distance average (Xave) between history empty vehicles of the distance between two cars is computed, and it considers as the 1st mode determined according to this distance-between-two-cars average (Xave) at least. As a flow chart shows the example to drawing 4 , or from the history of the foot transfer time from an accelerator pedal 20 to a brake pedal 21 or

[ considering as the 2nd mode which computes a mean time (Tave) and determines a buffer distance (X2) according to this mean time (Tave) at least ] -- or As a flow chart shows the example to drawing 5 , from the history of the vehicles order deceleration under braking [ whether it considers as the 3rd mode which computes average braking deceleration (Gave) and determines a buffer distance (X2) according to this average braking deceleration (Gave) at least, and ] or as the 4th mode which determines a buffer distance (X2) according to the size of three physical quantity, these distance-between-two-cars average (Xave), a mean time (Tave), and average braking deceleration (Gave) Processing for setting up the above-mentioned threshold (Xsum) from this buffer distance (X2) and above-mentioned brake stopping distance (X2) is also performed.

[0043] When using any one sort of three sorts of historical data mentioned above, any two sorts, or three sorts of all of those here, it is good for the memory of the store circuit in a control unit 29 to constitute including the non-volatile memory which accumulates the corresponding data in the time of the past run and which can carry out things.

[0044] In the following example programs, in the determination of a buffer distance (X2), and a setup The brake stopping distance which has shown the example which adopted the method by the 4th mode of the above which can perform this more finely, computes relative velocity from distance and the self-vehicle speed with a front detection object, and is computed from relative velocity (X1), The sum (Xsum) with the buffer distance (X2) computed from the self-vehicle speed is made into a threshold. In the case of composition of giving a pressure higher than the brake pressure which approaches when the actual distance between two cars is less from this threshold, judges to be Japanese cryptomeria, and is generated by the brakes operation of a driver Furthermore, specifically, a control unit 29 also performs processing according to the control program by each routine shown in each of drawing 3 , drawing 4 , drawing 5 , drawing 6 , and drawing 7 . And the foot-transfer-time mean time obtained from the history of the foot transfer time from an accelerator pedal 20 to a brake pedal 21 in this processing process (Tave), According to the size of three physical quantity of the distance-between-two-cars average (Xave) acquired from the history of the distance between two cars, and the average braking deceleration (Gave) obtained from the history of the deceleration of the vehicles under braking, as determining a buffer distance (X2) The peculiarity of a driver (owner-driver of the vehicles concerned) is made to grasp appropriately and certainly by monitoring any element of how to take pedal operation of a driver, vehicles information (braking G), and the distance between two cars continuously. By setting up the threshold (Xsum) of the distance between two cars corresponding to the property of the driver concerned, a dangerous situation is detected exactly and brake assistance is carried out.

[0045] Drawing 3 - drawing 7 are flow charts which show data processing of a control unit 29. This routine is an interrupt handler performed a predetermined period (it considers, for example as the period which flows once to 10msec(s) in this example).

[0046] Steps S100-S110 ( drawing 3 ) are the study routines of the distance-between-two-cars average at the time of a usual run. First, in Step S100, the vehicle speed (self-vehicle speed) is read from the rotational speed of a wheel based on the detecting signal of a sensor 28 to detect the car body speed of a self-vehicle. Next, in Step S101, it is judged for the vehicle speed whether it is less than a set point ** predetermined value (km [ for example, / 5 //(h) ]). This finds whether it is at the time of a 1 fixed-speed run. Thus, it is judged to the setting vehicle speed of the after-mentioned [ the vehicle speed read at Step S101 ] whether it is almost equal. When equal, it progresses to henceforth [ Step S102 ] (when the answer of Step S101 is affirmation (Y)). When that is not right, the store (namely, renewal of the setting vehicle speed) of the vehicle speed present at Step S106 is carried out to the setting vehicle speed (when the answer of Step S101 is negative (N)), and it progresses to the routine after Step S200 ( drawing 4 ).

[0047] When the answer of Step S101 is affirmation, it can be concluded that it is in a 1 fixed-speed run state. in this case In Step S103 which increments the timer (for example, the 1st timer which consists of a rise counter) which manages the time for asking for one data of the distance between two cars at Step S102, and continues The distance between two cars (X) is read based on the information from the laser radar sensor 31 that distance with the front vehicles as a front detection object of self-vehicles is detectable.

[0048] Next, at Step S104, it is judged whether it is that the time check by the 1st timer of the above carried out predetermined-time progress (deadline), when it passes, it progresses to the distance-between-two-cars calculation routine after Step S107, and when having not passed, the calculation is not carried out. When processing is advanced by the loop which passes through such step S103 ->S104 ->**, it has an interval for every step S103 execution, and reading by this step S103 is performed to the corresponding timing, and each reading data is memorized until it carries out this predetermined-time progress. Thereby, the distribution of the distance between two cars between the predetermined times concerned can be seen.

[0049] When the 1st timer passes the deadline of, the following processings are performed only at once. Although it makes to calculate the average of the distance between two cars into a fundamental content, in the case of this example program, the distance-between-two-cars calculation routine is constituted there including each processing of calculation (Step S109) of an average of the vehicle speed with distinction (Step S105) of being a low speed, calculation (Step S107) of the distance-between-two-cars average, calculation (Step S108) of the distance between two cars/vehicle speed, and old old distance between two cars/vehicle speed.

[0050] First, in Step S105, it is judged for the vehicle speed from the predetermined vehicle speed whether it is a low speed. Consequently, when an answer is in the low-speed state of under the predetermined vehicle speed in affirmation, Steps S107-S109 are skipped, only Step S110 (timer clearance) is performed, and when an answer is negative, Steps S107-S109 and processing of S110 are performed once to the timing. Therefore, the distance-between-two-cars calculation routine of Steps S107-S109 does not perform from a standpoint that it is not suitable for study of the distance-between-two-cars average at the time of a usual run from a viewpoint in this brake assistant control that a driver [ brakes operation ] will be assisted at the time of a low speed, i.e., a run state which is not filled with the time of a 1 fixed-speed run into the predetermined vehicle speed. Therefore, even when determining a buffer distance (X2) from the state of a distribution of the distance between two cars, as a result of making the distance-between-two-cars information at the time of the 1 fixed-speed run more than the predetermined vehicle speed with an object chiefly, although required sufficient suitable buffer distance is defined, it will become more exact and improvement in precision can be aimed at. Therefore, in the scene where Steps S107-S109 are skipped, as a result of not being set as the object of the accumulation as historical data, even when it is going to determine a buffer distance according to the distance-between-two-cars average acquired from the history of the distance between two cars, also about the part and the historical data to apply, the data based on the distance between two cars in the run state will become more exact, and can aim at improvement in precision again.

[0051] when a deer is carried out and the vehicle speed is judged to be more than the predetermined vehicle speed at Step S105, in Step S107, the value of the distance-between-two-cars data memorized between the above-mentioned predetermined times (Step S104) is equalized (this calculation value will be cut also with what [ exact ] has the few bias which does not have dispersion more if this is further used together with the past historical data), and it transposes to the numeric value according to the vehicle speed at Step S108 further at this example program Here, it has supposed that it asks for the distance between two cars/vehicle speed, and this means having transposed the above-mentioned average about the distance between two cars obtained this time to the value (average) of the distance between two cars per vehicle speed. In addition, you may make it use the inverse number, i.e., the vehicle speed/distance between two cars, of this in this case.

[0052] And in Step S109 following Step S108, the macro average is computed including the average data accumulated until now, the 1st timer is cleared at Step S110, and the routine of drawing 1 is ended. In this way, the value acquired at Step S109 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0053] It turns out what the distance between two cars the driver is having and running usually by the above routine. Furthermore, in this example program, it is aimed above also at the history of the past distance between two cars. It can ask for an average thing from the history, and the peculiarity of the driver about the part and the distance between two cars can be grasped appropriately and certainly. The

thing of a state with few biass about whether the driver is running with the distance between two cars of how much usually is obtained. As a result of reflecting this in a setup of a buffer distance X2, the approach threshold XL (Step S404) corresponding to the property about how to take the distance between two cars of the driver more effectively and the feature can be set up.

[0054] Steps S200-S210 ( drawing 4 ) are routines which compute the average of the foot transfer time from an accelerator pedal 20 to a brake pedal 21. First, in Step S200, when it is judged whether it gets into the accelerator pedal 20 based on the information from the accelerator stroke sensor 22 and it gets into it (accelerator-on), it progresses to the processing which passes through Steps S209 and S210, and when that is not right, it progresses to Step S201.

[0055] In the case of the ** dull **** operation to a brake pedal 21 from the accelerator pedal 20 by the driver, A flag set here at Step S209 is a control flag for processing so that one data (foot-transfer-time data) may be obtained per step on substitute, is set at this step S209, and is cleared at the below-mentioned step S209. Moreover, the timer cleared at Step S210 is a timer (for example, the 2nd timer which consists of a rise counter) used for the time check of foot transfer time. At the time under accelerator-on, the processing by the side of the above-mentioned step S209 and S210 is always chosen for a driver to prepare for the ** dull operation of releasing an accelerator pedal 20 next and breaking in a brake pedal 21, and prepare for the surveillance of the ****, and calculation of the foot transfer time at that time.

[0056] If an accelerator pedal 21 is released, Step S200 will change processing to Step S201 side. At this step S201, when it is judged based on the information from the brake stroke sensor 23 whether it gets into the brake pedal 21 and it does not get into the brake pedal 21 by the loop this time, the 2nd timer in which foot transfer time is shown at Step S208 is incremented, and this routine in a loop is ended this time. Thereby, according to the driver having separated the leg from the accelerator pedal 21, it starts and the thing of the time check of foot transfer time can be carried out.

[0057] Processing is further advanced to henceforth [ Step S202 ] to check the time which the timing which regarded as **** from an accelerator pedal 20 to a brake pedal 21 having been made by the driver when carrying out a deer, progressing to Step S201 from Step S200 next time after a loop and coming to get into a brake pedal 21 (brake-on), and the answer of this step S201 converted into negative from affirmation took for the ****.

[0058] When getting into the brake pedal 21, first, it is Step S202 and it is judged whether the above-mentioned A flag for restricting to one data per step on substitute is set (that is, was the average of foot transfer time already computed like the after-mentioned or not?). Since the A flag concerned is in a set state by Step S209 by the loop of the beginning immediately after making the above-mentioned **** here, by the loop of the beginning of the immediately after concerned, Step S202 performs processing not more than step S203 only at once. And as a result of performing Step S207 (A flag clearance) at once then, as that to which calculation was already carried out, this routine is ended from Step S202 in that case, and, henceforth [ the following loop ], it progresses to the routine after Step S300.

[0059] Although it makes into a fundamental content for the data about foot transfer time to ask for the time taken at above **** here with the timer value of the 2nd timer Furthermore, distinction of whether in the case of this example program, this timer value is more than over the predetermined time (for example, 1 second) (Step S203), It constitutes including each processing of calculation (Step S205) of the set (Step S204) to the foot transfer time of a timer value, and the average with old foot transfer time.

[0060] First, in Step S203, it is judged whether the 2nd timer in which foot transfer time is shown passed 1 second or more. Consequently, when an answer is judged that 1 second or more passed by affirmation, it excepts from calculation of the average and skips to Step S206 (timer clearance), only this step S206 and Step S207 (A flag clearance) are performed, and when an answer is negative, processing of Steps S204 and S205 is performed once under the conditions below timer 1 second. Therefore, in the case of the state of **** from the accelerator pedal 20 with which the 2nd timer value for the time check of foot transfer time passes 1 seconds or more to a brake pedal 21 From it not being suitable as foot transfer time from a viewpoint how much ** dull **** of time the driver has required in the brakes operation in the time of a usual run even if -- an accelerator pedal 21 -- releasing -- and after that brake ** -- dull -- a

series of operations of breaking in 22 were performed -- an imitation -- it can avoid adopting such foot-transfer-time data in this example therefore, the time concerning *** in ** dull operation -- taking into consideration -- a buffer distance -- a law -- foot-transfer-time information even when considering as a way, in case foot transfer time is less than a predetermined time (this example 1 second) chiefly -- an object -- it can do -- the need -- although sufficient suitable buffer distance (X2) is defined, it will become more exact and improvement in precision can be aimed at Moreover, the set to the foot transfer time by processing at Step S204 is not carried out, either, but there is no 2nd timer value data in such a * ** state, if it is the object of the accumulation also as historical data. a result -- brake ** from an accelerator pedal 21 -- dull -- even when it is going to determine a buffer distance according to the average of the foot transfer time acquired from the history of the foot transfer time of 22, from calculation of a mean time (Tave), also about a part to be excepted and the historical data to apply, the historical data to which foot transfer time exceeds a predetermined time will become more exact, and can aim at improvement in precision

[0061] A deer is carried out and as a result of judgment at Step S203, if the 2nd timer value is less than 1 second, the timer value concerned is set as foot transfer time at Step S204. And in continuing Step S205, the average including the foot transfer time accumulated until now is computed, the 2nd timer and A flag are cleared at Steps S206 and S207, and this routine is ended. In this way, the value acquired at Step S205 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0062] the above routine -- a driver -- brake ** from an accelerator pedal 21 -- dull -- in case **** is carried out to 22, it turns out how much foot transfer time is usually applied to it Furthermore, in this example program, it is aimed above also at the history of the past foot transfer time. It can ask for an average thing from the history, and the peculiarity of the driver about the part and foot transfer time can be grasped appropriately and certainly. The thing of a state with few biass about by how much foot transfer time the driver is carrying out ** dull operation usually is obtained. as a result of reflecting this in a setup of a buffer distance X2, the approach threshold XL (Step S404) which balanced the property about the ** dull operation for **** of the driver and the feature more effectively is set up -- things are made

[0063] Steps S300-S312 ( drawing 5 ) are routines which supervise the braking G which is the vehicles information relevant to brakes operation, and calculate average braking deceleration. first, in Step S300, when it is judged whether it gets into the brake pedal 21 based on the information from the brake stroke sensor 23 and you get into it (brake-on), progress to Step S301, and when that is not right, pass processing of Steps S311 and S312 -- the timer and G flag related to this routine are cleared, and it ends

[0064] The timer cleared at Step S311 here is a timer (for example, the 3rd timer which consists of a rise counter) used in order to see the slowdown G of a predetermined time. Moreover, G flag is a control flag for processing so that one data may be adopted per [ by brake treading in ] slowdown. brake ** -- dull -- while 21 is not stepped on, Step S300 has always chosen the processing by the side of the above-mentioned step S311 and S312 to prepare for calculation of the deceleration under the braking when a driver next broke in and brakes a brake pedal 21

[0065] If it gets into a brake pedal 21, Step S300 will change processing to Step S301 side during the brake treading in concerned henceforth. At Step S301, it is judged whether G flag for adopting one data per [ by brake treading in ] slowdown is set. Although a routine is ended from this step S301 here when set (i.e., when it was already under braking this time and slowdown data storage is performed) By the loop of the beginning immediately after making treading in to the above-mentioned brake pedal 21 From it being in the change state by Step S312, first these G flags by the loop of the beginning of the immediately after concerned Step S301 will choose less than [ step S302 ], processing will be advanced, and processing which passes through Step S302 or subsequent ones is performed until the distinction result in the step S301 converts henceforth, when progressing to Step S301 from Step S300.

[0066] That is, when G flag is not set, at Step S302, reading of Slowdown G is performed based on the information from every this step S302 execution and the order G sensor 32. thereby -- brake ** -- dull -- the slowdown G of vehicles is always supervised during vehicles braking accompanying treading in of

21 Next, in Step S303, it is judged for the read slowdown G whether it is less than a set point ** predetermined value (for example, 0.05G). This finds whether predetermined within the limits has the slowdown G at that time. Thus, it is judged, when equal, it progresses to henceforth [ Step S304 ], and whether the slowdown G serially read at Step S302 is almost equal to the set point updates the set point at Step S310, when that is not right, and it ends this routine from this step S310, and progresses to the routine after Step S400 ( drawing 6 ).

[0067] When the answer of Step S303 is affirmation, it can conclude that the vehicles deceleration under brake treading in by the driver is within the limits of predetermined, and it is judged at Step S304 in this case whether it is that incremented the 3rd timer for seeing the average of the slowdown G of a predetermined time, and the time check by the timer carried out predetermined-time progress in continuing Step S305 (deadline). Thereby, it is judged whether calculation of an average of Slowdown G is possible. And Steps S306-S309 are skipped until the 3rd timer passes the deadline of, and this routine is ended. Thus, reading by every step S302 execution and this step S302 is performed, and each reading data can be memorized until this predetermined time passes, when processing is advanced by the loop which passes through step S302 ->S303 ->S304 ->S305 ->**. On the other hand, if this predetermined time passes and the 3rd timer passes the deadline of, it will progress to the processing after Step S306 to the timing.

[0068] It can use for the computation not more than step S306 for the information on the slowdown G when time for the slowdown G under brake treading in to be within the limits of predetermined carries out predetermined-time progress by this in this way. Here, processing not more than step S306 is performed only at once to adopt one data per the basis of such conditions, and slowdown. Although it makes to calculate the average of the slowdown G in this case into fundamental contents there, it constitutes from this example program including each processing of calculation (Step S306) of the average slowdown G, and calculation (Step S307) of the average with old average slowdown G data.

[0069] That is, in Step S306, the average of the slowdown G in the above-mentioned predetermined time (Step S305) is calculated. If this calculated value is relatively large here as for this as a result of being what is chiefly computed only under the above conditions, here, the part and its driver Can conclude that there are the inclination and the feature to which sudden braking is applied almost relatively, and if this calculated value is relatively small, the part and its driver it can be concluded that there are the inclination and the feature to which ****** is applied almost relatively (if this calculation value has such semantic attachment and this is further used together with the past historical data, it will cut this presumption also with what [ exact ] has the few bias which does not have dispersion more) And in Step S307, the macroscopic average is computed from the average accumulated until now, the change of G flag and the clear processing of the 3rd timer by Steps S308 and S308 are carried out after that, and this routine is ended. In this way, the value acquired at Step S307 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0070] brake ** according to a driver at the above routine -- dull -- the deceleration of the average vehicles concerned produced usually is known during treading in of 21 Even when seeing the slowdown G between predetermined times, the slowdown G when time for the slowdown G under brake treading in to be within the limits of predetermined carries out predetermined-time progress chiefly can be used for calculation of the average, except it, as a result of being able to do the outside of an object, although required sufficient suitable buffer distance (X2) is defined, it will become more exact and improvement in precision can be aimed at in this brake assistant control. moreover, even when reading the slowdown G which the vehicles under braking produce, under conditions to which Steps S307 and S308 are skipped As a result of not being set as the object of the accumulation as historical data, even when it is going to determine a buffer distance according to the average braking deceleration obtained from the history of the deceleration of the vehicles under braking, also about the part and the historical data to apply, the data of the slowdown G will become more exact and can aim at improvement in precision.

[0071] In this example program, it is aimed above also at the history of the slowdown G of the vehicles under past braking. It can ask for an average thing from the history, and the peculiarity of the driver seen from the slowdown G under the part and brake treading in can be grasped appropriately and certainly.

During braking by treading in of 21, take lessons from what braking G arises usually on vehicles, and the thing of a state with few biass is obtained. brake ** of a driver -- dull -- this can set up the approach threshold XL (Step S404) corresponding to the property about the generating braking G as the result reflected in a setup of a buffer distance X2, and vehicles information more effectively concerning the brakes operation of the driver, and the feature

[0072] Steps S400-S409 ( drawing 6 ) are routines which will set up the threshold that it is risk if it is related with the distance between two cars and approaches above, and set up the parameter of brake assistant control. First, in Step S400, the distance X between detection value empty vehicles of the laser radar sensor 31 is detected, and the relative velocity Vr (=dX/dt) with a front obstruction is calculated at Step S40. Furthermore, at Step S402, the physical stopping distance X1 (=Vr [2 ] / 2g) at the time of slowing down with a certain deceleration g is calculated.

[0073] Next, in Step S403, by this example program, the feature of a driver is presumed and a buffer distance X2 is set up from drawing 3 , drawing 4 , the average about the distance between two cars obtained by each routine (Step S100- S110, S200-S210, S300-S312) of drawing 5 , the foot-transfer-time average, and the slowdown G average. As this example, a relation as shown in the following table 1 is shown.

[0074]

[Table 1]

| 車間距離 | 踏替時間 | 制動 G | 運転者の特徴 | 余裕距離 |
|---|---|---|---|---|
| 大 | 大 | 大 | 安全志向、瞬発力高い、認知遅い | 大 |
| 大 | 大 | 小 | 安全志向、瞬発力高い、認知速い（熟練） | 中 |
| 大 | 小 | 大 | 安全志向、瞬発力低い、認知遅い（高齢・女性） | 大大 |
| 大 | 小 | 小 | 安全志向、瞬発力低い、認知速い | 大 |
| 小 | 大 | 大 | 接近派、瞬発力高い、認知遅い | 小 |
| 小 | 大 | 小 | 接近派、瞬発力高い、認知速い（せっかち派） | 小小 |
| 小 | 小 | 大 | 接近派、瞬発力低い、認知速い | 小 |
| 小 | 小 | 小 | 接近派、瞬発力低い、認知遅い | 中 |

[0075] Next, in Step S404, if it approaches more than this, the approach threshold XL that it is risk (it is less than the state; safety distance which passing approaches) will be computed. This setup was made into the sum of the stopping distance X1 which is physically rich, and the buffer distance X2 concerning cognition and ****. therefore, the stopping distance X1 as a brake stopping distance computed from relative velocity Vr in this example program and each above-mentioned average (the distance between two cars / vehicle speed average --) In continuing Step S405, by judging whether the actual distance between two cars X is larger than this threshold XL by making into a threshold the sum with the buffer distance X2 set up according to the foot-transfer-time average and three physical quantity of the average slowdown G When it approached when the distance between two cars X at that time was less from this threshold XL, and it can be judged as ****, it approaches and it is judged as ****, the brake assistance which gives brake pressure higher than the brake pressure generated by the brakes operation of a driver can be made to perform.

[0076] When it does in this way, appropriately as an adjustable controlled variable which applies a buffer distance X2 to the stopping distance X1 Determination, Can set up and the aggravation of a feeling depended for going into brake assistance frequently and being effective too much if it depends for the threshold of a safety distance on the composition defined uniquely, although the operation pattern of a driver is various is caused. Or situations like -- the effect of original of a system fades conversely -- can also be avoided, the approach threshold XL corresponding to the property of the driver can be set up, correspondence nature can be raised, and the function of brake assistant control can be

demonstrated appropriately the neither more nor less.
[0077] As illustrated to the above-mentioned table 1, when a buffer distance X2 is set up according to the size of three physical quantity, foot transfer time, the distance between two cars, and Braking G (slowdown G), in this case It is possible to grasp the peculiarity of the driver more appropriately and certainly by monitoring all of how to take * dull operation of the driver, Braking G, and the distance between two cars continuously. In a setup of a buffer distance X2, this can be performed more finely, the feature of the driver concerned can be correctly presumed from all the field of them for any element, and the optimal buffer distance X2, therefore the optimal approach threshold XL can be set up.
[0078] The buffer distance X2 should respond to the distance between two cars, foot transfer time, and the combination of the size of three elements of Braking G here in Table 1. About distinction of the size of each element, the predetermined value for distinction about the foot-transfer-time average is established [ average / foot-transfer-time ], for example, and it is about whether it is beyond this predetermined value. Moreover, about the distance-between-two-cars average, the predetermined value for distinction about the distance-between-two-cars average is established, and it is about whether it is beyond this predetermined value. Moreover, about the slowdown G average, the predetermined value for distinction about the slowdown G average is established, and it is about whether it is beyond this predetermined value. the method of distinguishing size of ******** -- it can carry out -- therefore -- Table 1 -- the combination of this size -- as the feature of a driver -- the thing of the 1st column to the octavus column -- a case -- dividing -- carrying out -- having -- **** .
[0079] And about the buffer distance X2, the value of the buffer distance which should be added is assigned according to this. Five fields, "small smallness", "smallness", "inside", "size", and "size size", are classified, and each field is received here. in this order The value of a buffer distance respectively smaller than " as a predetermined value defined beforehand", Like "the value of a small buffer distance", "the value of the buffer distance of the degree of middle", and "big value" of a buffer distance and the value of a bigger buffer distance than "", the value of five sorts of buffer distances X2 can be set up, and it can set up finely.
[0080] In addition, even if this invention does not bar carrying out without using together all of these three elements, and each routine of drawing 3 , drawing 4 , and drawing 5 is independently used for it, respectively and it carries it out combining the routine of this drawing 6 and following drawing 7 , the mode which combines drawing 3 , drawing 4 , any two combination of each routine of drawing 5 , and the routine of this drawing 6 and following drawing 7 is sufficient as it.
[0081] Like previous statement in the aforementioned step S405, although it is the judgment step of distance-between-two-cars >XL, by this example program, the following processings are also further considered in less than [ step S405 ]. That is, the value of bus-available threshold which determines the timing which it is judged whether the actual distance between two cars is larger than the approach threshold XL, chooses the treading strength / the braking G property usual at Step S406 at Step S405 according to the result since it still is not dangerous when large, and starts the below-mentioned assistant control (Step S505) at continuing Step S408 is enlarged.
[0082] It is made easy for Braking G to become large to treading strength rather than usual at Step S407, to choose the property which strengthens effectiveness, to, make small the value of bus-available threshold which determines the timing which starts assistant control at Step S409 on the other hand, when [ with the actual distance between two cars smaller than the approach threshold XL ], namely, passing approaches, and to start brake assistant control.
[0083] Thus, as brake treading strength / a damping characteristic, two properties (Step S406), i.e., normal normal brake treading strength / damping characteristic, and the brake treading strength / damping characteristic of high gain (Step S407) are prepared beforehand, and it controls to change these alternatively and to make them apply according to the result of Step S405. Thus, as fluid-pressure gain over the brake input by the driver may be made high at the time of the brake assistance which gives brake pressure higher than the brake pressure generated by the brakes operation of a driver when it approaches and is judged as ****, it can perform it, and it may consider this control. In this case, at the time of the brake assistance, rather than usual, the braking fluid pressure exceeding the brakes operation

force more quickly can be started, and it can respond to brake assistance appropriately.
[0084] Steps S500-S508 ( drawing 7 ) are brake assistant control routines. first, the step S500 -- setting -- the detecting signal from the brake stroke sensor 23 -- being based -- brake ** -- dull -- the amount of strokes of 21 is detected and brake stroke speed is computed from the variation of a predetermined time at the following step S501 thereby -- brake * -- dull -- the brake input speed of the driver in process in which 21 is broken in is detectable as brake stroke speed
[0085] Continuing Step S502 is a step a brake pedal 21 judges it to be whether it is OFF (there is nothing brake ** dull **** rare ****). As a result of judgment at this step S502, in OFF, bus-available flag is cleared at Step S509, and it cancels assistant control. If bus-available flag enters at assistant conditions, and shows whether it is under [ control ] ******** and this flag is set here (Step S509), it is a flag meaning assistant being under control.
[0086] On the other hand, when getting into the brake pedal 21 as a result of judgment of Step S502 Furthermore, it is judged whether this bus-available flag that goes into assistant conditions and shows whether it is under [ control ] ******** in Step S503 is set. When assistant control is already started when set namely, it progresses to Step S505 (assistant control), and control is continued, and since when that is not right finds whether it is in the timing which should carry out assistant control, processing is advanced for Step S504.
[0087] At Step S504, it is judged whether brake stroke speed (Step S501) is larger than bus-available threshold. A judgment at this step S504 is for giving the predetermined assistant force, when the detection brake stroke speed in the brake ** dull 21 treading-in process of a driver exceeds rather than bus-available threshold by this. And at this example program, bus-available threshold used here is determined at the aforementioned steps S408 and S409 ( drawing 6 ). since [ therefore, ] it was judged that it approached too much in the aforementioned step S405 -- as the bus-available threshold -- smallness -- when bus-available threshold is chosen, this will be interlocked with, this bus-available threshold will be applied as a bus-available threshold for distinction at this step S504, and the judgment with brake stroke speed can be performed
[0088] As a result of a judgment at Step S504, when brake stroke speed is larger than bus-available threshold (i.e., when treading in with a brake is large), it presumes that it is urgent, and assistant control is performed at Step S505, and bus-available flag is set at Step S507. On the other hand, although assistant control is not performed as a result of a judgment when brake stroke speed is not larger than bus-available threshold (Step S506), it is Step S508 and treading strength and braking G feedback control are performed based on the defined gain in Step S504. What gain here was determined as at the aforementioned steps S406 and S407 ( drawing 6 ) is used.
[0089] In this way, once the answer of the step S504 is affirmed by the loop of step S502 ->S503 ->S504, brake assistant control will be started to the timing. As a concrete example which gives the predetermined assistant force to it when brake stroke speed exceeds here rather than bus-available threshold, in order to perform assistant control here at Step S504 A control unit 29 drives a solenoid valve 45 so that the vacuum valve 43 of the aforementioned negative pressure booster 25 of drawing 2 may serve as a closed position and a breather valve 44 may serve as an open position, by introducing the atmosphere into the transformation room 41, generates differential pressure with the negative pressure room 42, and generates a fluid pressure in a master cylinder 26 - a wheel cylinder. Therefore, thereby, assistant control is performed.
[0090] According to this brake assistant control as mentioned above, it can respond also to various operation patterns of a driver as if assistant control can be made to perform at the time of the brakes operation of a driver. By monitoring how taking ** dull operation of a driver, braking deceleration, and the distance between two cars continuously, in view of the property of the driver, the peculiarity of the driver concerned can be grasped, the approach threshold of the distance between two cars corresponding to the property of the driver concerned can be set up the more nearly optimal, and the state where passing approaches exactly is detected, and for the driver concerned, a system can carry out brake assistance and becomes what has brake assistance more suitable for the driver concerned. This system also for a driver with the feature vacates the distance between two cars conversely also for a driver with

the feature which packs and runs the distance between two cars, and it runs therefore, further Also for each driver which has the feature separately depending on how to apply pedal operation and braking from skillful degree age etc. The effect of having correspondence nature it being large, possible correspondence and high also in these drivers, and making them demonstrating the function of brake assistant control original appropriately the neither more nor less can be pulled out further.

[0091] As a concrete example of which assistant control is canceled at Steps S506 and S509 on the other hand, a solenoid valve 45 shall be driven and control shall be ended so that the vacuum valve 43 of the aforementioned negative pressure booster 25 may serve as an open position and a breather valve 44 may serve as a closed position. In addition, since the vacuum valve 43 serves as an open position and a breather valve 44 serves as a closed position by the energization force of a spring, intercepting energization of a solenoid valve 45 is also given to the purpose of a control end.

[0092] In addition, this invention is not limited to the form of the above operation. For example, although the buffer distance was gradually set up in the aforementioned table 1 when three physical quantity was used, this invention is not restricted to the method of setting up a buffer distance gradually such, and can be carried out also by the method of calculating the value of a synthetic buffer distance, by using these three physical quantity as reference data using the table and map which made property data memorize beforehand.

[0093] Moreover, it is a book, even if it uses brake treading strength, a brake fluid pressure, etc. not only instead of this but instead of brake stroke speed, although composition which performs assistant control is made into **-SU in the example of the above-mentioned control program for example, when brake stroke speed exceeds the threshold for the comparison.

[0094] moreover, the brake assistant method which performs assistant control which generates the predetermined damping force (braking fluid pressure) exceeding the brakes operation force of a driver is not the thing to depend on a negative pressure booster 25 like drawing 2 and which is restricted -- needless to say -- moreover, this invention -- electromagnetism -- it is widely applicable including the case where it is based on a brake system

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[Translation done.]

* NOTICES *



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TECHNICAL FIELD

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[The technical field to which invention belongs] this invention relates to the brake assistant system of vehicles.

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PRIOR ART

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[Description of the Prior Art] As a brake assistant system, there are some which were indicated by JP,4-25182,B (reference 1). when distance with a front obstruction is less than a safety distance, while carrying out the alarm of the risk to an operator by reference 1 -- brake ** -- the attempt which carries out auxiliary braking of the brake pressure at the time of dull treading in is proposed

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## EFFECT OF THE INVENTION

[Effect of the Invention] While according to this invention having each of each means according to claim 1 and being able to make brake assistant control perform by the above-mentioned composition at the time of an operator's brakes operation, if possible, it closes easily determining and setting up the buffer distance appropriately, as an adjustable controlled variable applied to the calculation brake stopping distance, this brake assistance being carried out and cheating from a viewpoint of the above-mentioned consideration matter as the neither more nor less effective thing. Depending on therefore, the composition which defines the threshold of a safety distance uniquely although an operator's operation pattern is various The place where the aggravation of a feeling depended for being effective too much is caused at although it will go into brake assistance frequently therefore, or the effect of original of a system fades in this invention Such a situation can be avoided, the threshold corresponding to an operator's property can be set up, correspondence nature is raised, there are also no excess and deficiency, and it becomes possible to realize the improved brake assistant system in which is made to demonstrate the function of brake assistant control appropriately, and it deals.
[0024] A threshold setup can be performed here according to either or all the elements of how to take ** dull operation of the operator, braking deceleration, and the distance between two cars, if the threshold is set up like according to claim 2. Therefore, by grasping the peculiarity of the operator concerned by this The threshold of the distance between two cars corresponding to the property of the part and the operator concerned can be set more as an optimum. The state where passing approaches exactly is detected, and for the operator concerned, in view of the operator's property, a system can carry out brake assistance and if possible, it closes making it become what has brake assistance more suitable for the operator concerned.
[0025] in this case, about the buffer distance applied to be added to the brake stopping distance For example, it has each calculation means at least like claim 3 or claim 5 publication. In the mode which determines a float according to this mean time from a means to compute a mean time, from the history of the foot transfer time from an accelerator pedal to a brake pedal In or the mode which determines a float from the history of the distance between two cars according to this distance-between-two-cars average from a means to compute the distance-between-two-cars average Or as composition by one of the modes of the mode which determines a float from the history of the vehicles order deceleration under braking according to this average braking deceleration from a means to compute average braking deceleration, this invention can be carried out suitably and can realize the above-mentioned thing similarly. Furthermore, as a result of the thing of a state with few the biass about whether can ask for the average corresponding thing from the history of the element with which the past corresponds in these cases, and can grasp the peculiarity of the part and its operator appropriately and certainly, for example, the operator concerned is running with the distance between two cars of how much usually is obtained and being reflected this in a setup of a buffer distance, the threshold which balanced the operator's property and the feature more effectively can set up.
[0026] Moreover, as composition according to claim 6 which determines a buffer distance like according to the size of all three physical quantity, the mean time of these foot transfer time, the

distance-between-two-cars average, and average braking deceleration, this invention can be carried out suitably and can realize the above-mentioned thing similarly preferably. In addition, it is possible by monitoring all of how to take ** dull operation of the operator, braking deceleration, and the distance between two cars in this case continuously to make the operator's peculiarity grasp more appropriately and certainly. Therefore, in a setup of a buffer distance, and determination, this can be performed more finely, the feature of the operator concerned can be correctly presumed from all the field of them for the average about the foot transfer time, the distance-between-two-cars average, and any element of average braking deceleration, and the optimal buffer distance, therefore the optimal threshold can be set up. Also for an operator with the feature vacates the distance between two cars conversely also for the operator who has the feature which packs and runs the distance between two cars again, and it runs, therefore, further Also for each operator who has the feature separately depending on how to apply pedal operation and braking from skillful degree age etc. It has correspondence nature it is large, possible correspondence and high also to these operators, and the above-mentioned effect of demonstrating the function of brake assistant control original appropriately the neither more nor less can be pulled out further. about the threshold concerned, if it approaches more than this, as an approach threshold of being less than a safety distance, it may be set up as a value which consists of the sum of the stopping distance which is physically rich, and the buffer distance concerning cognition and ****, and the function will be achieved well here -- it becomes

[0027] Moreover, when determining a buffer distance according to the size of the foot-transfer-time average, the distance-between-two-cars average, and the physical quantity of average braking deceleration, this invention can be suitably carried out in like and the mode which sets up the value of the buffer distance according to claim 7 or 8. In this case, it should respond to the foot-transfer-time average, the distance-between-two-cars average, and the combination of the size of three physical quantity of average braking deceleration by doing in this way. therefore -- for example, the combination of this size -- as an operator's feature -- a maximum of eight sorts of things -- a case -- a division -- possible -- it -- doubling -- the above-mentioned addition -- the value of the buffer distance which should be carried out can be assigned According to the suitable example, the value of a buffer distance can set this up like the value of a degree, a big value, and a bigger value a for example more small value, a small value, and middle, and can be set up that much finely. But this invention is not restricted to the method of setting up a buffer distance gradually in this way, and can be carried out also by the method of calculating the value of a synthetic buffer distance, by using these three physical quantity as reference data using the table and map which made property data memorize beforehand.

[0028] Moreover, when this invention computes the mean time from the history of the foot transfer time from an accelerator pedal to a brake pedal, the historical data according to claim 9 to which foot transfer time exceeds a predetermined time can be suitably carried out from calculation of a mean time like as composition to except. thus -- if it carries out -- the above-mentioned effect -- in addition, a series of ** dull operations of having released an accelerator pedal even if and breaking in brake ** DARU after that were performed -- an imitation -- Although the historical data exceeding such a predetermined time can be excepted from calculation of the mean time of foot transfer time, can do foot-transfer-time information in case foot transfer time is less than a predetermined time chiefly with an object and a buffer distance is defined It will become more exact, precision can be raised and rationalization of this brake assistant control can be attained. Moreover, it is not necessary to make into an object foot transfer time at the time of the state of **** from an accelerator pedal with which the time which such **** takes also exceeds a predetermined time to a brake pedal also as historical data. Even when it is going to determine a buffer distance according to the foot-transfer-time average acquired from the history of the foot transfer time, also about the history of the part and the foot transfer time to apply, it will become more exact and improvement in precision can be aimed at.

[0029] Moreover, in this invention, it can consider as the composition according to claim 10 which determines a buffer distance like from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed. thus -- if it carries out -- the above-mentioned effect -- in addition, the information on the distance between two cars can be excepted

by low-speed run state which is not filled with the time of a 1 fixed-speed run into the predetermined vehicle speed, the distance-between-two-cars information at the time of the 1 fixed-speed run more than the predetermined vehicle speed is chiefly made with an object, to defining a buffer distance, it will become more exact, precision raises, and rationalization of this brake assistant control can attain to it Moreover, the distance between two cars at the time of such a low-speed run does not need to consider as an object as historical data, even when it is going to determine a buffer distance according to the distance-between-two-cars average acquired from the history of the distance between two cars, also about the history of the part and the distance between two cars to apply, will become more exact and can aim at improvement in precision. Moreover, in this case, it is good also as composition according to claim 11 which uses the distance between two cars / vehicle speed or the vehicle speed / distance between two cars instead of like and the distribution of the distance between two cars, and the above-mentioned thing can be realized similarly.

[0030] Moreover, this invention can be suitably carried out as composition [ like ] according to claim 12. In addition, vehicles deceleration when time for the vehicles deceleration under brake treading in to be within the limits of predetermined carries out predetermined-time progress chiefly can be used for calculation of the average. thus -- if it carries out -- the above-mentioned effect -- Can do the outside of an object except it and it will become more exact defining a buffer distance. Precision can be raised and rationalization of this brake assistant control can be attained. Moreover, it is not necessary to make vehicles deceleration in other than the above-mentioned condition into an object also as historical data. Even when it is going to determine a buffer distance according to the average braking deceleration obtained from the history of the deceleration of the vehicles under braking, also about the history of the part and the vehicles deceleration to apply, it will become more exact and improvement in precision can be aimed at.

[0031] Moreover, when [ according to claim 13 ] it approaches and is judged as **** like, it can carry out suitably as composition which makes high fluid-pressure gain over the brake input according this to an operator as a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation. in this case, in addition to the above-mentioned effect, at the time of brake assistance, the braking fluid pressure exceeding the brakes operation force more quickly can be started, assistant ** can be given, and it can respond to brake assistance appropriately, and may become effective at this point, and this invention may consider and carry out such control

[0032] Moreover, when it had a means to give a predetermined pressure when [ according to claim 14 ] an operator's brake input speed was detected and input speed exceeded rather than a threshold like, and approaches and is judged as ****, it can carry out as composition of the mode which makes the value of this threshold small. In this case, it is also preparing the threshold for comparison to an operator's brake input speed, and comparing the brake input speed detected with this. Are suitably [ in the case of the method which carries out brake assistance so that a predetermined pressure may be given, when the input speed exceeds rather than this threshold ] applicable. The distance between two cars approaching and being judged as **** is interlocked with, and the threshold for the comparison concerned is made small according to it. The judgment with the detection brake input speed can be performed, and this invention can also consider and carry out such control at the above times of a brake assistant method. Or it is [ like ] good again also as composition of the mode which enlarges the value of the pressure to give similarly when it has a means to give a predetermined pressure when [ according to claim 15 ] an operator's brake input speed is detected and input speed exceeds rather than a threshold, and the distance between two cars approaches and it is judged as ****. Also in this case, it can apply to the above-mentioned brake assistant method, and this invention can be carried out suitably.

[0033]

[Embodiments of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 and 2 are drawings showing one example of this invention, and drawing 1 is the whole block diagram. 20 and 21 show the accelerator pedal which an operator (driver) operates, respectively, and a brake pedal among drawing 1 . Brake stroke SENSATO 23 which detects the control input of this brake pedal is formed in a brake pedal 21. In this example, the accelerator stroke sensor 22

which detects the control input of this accelerator pedal is formed in an accelerator pedal 20.
[0034] Moreover, in this example, it has the master cylinder (M/C) 26 which is interlocked with the brakes operation by the brake pedal 21, and is made to generate a brake fluid pressure, and while leading the brake fluid pressure (damping force) which made it generate with this master cylinder to the wheel cylinder (W/C) of each wheel 27 of vehicles and making it make a brake act, a master cylinder 26 is equipped with the negative pressure booster 25 which contains the solenoid valve. Although the brake fluid pressure which answers the treading-in position of a brake pedal 21 is outputted at the time of treading in to the brake pedal 21 by the driver, when it corresponds like the after-mentioned, the master cylinder 26 which has this negative pressure booster 25 generates the damping force which can give brake pressure higher than the brake pressure generated by the brakes operation of a driver under the assistance by the negative pressure booster 25, therefore exceeds the operating physical force of a driver, and it deals in it.
[0035] Drawing 2 is the block diagram of a negative pressure booster, and, thereby, explains an example of the structure of the negative pressure booster 25 hereafter. The negative pressure booster 25 has a power piston 40, the transformation room 41 divided by the diaphram 54, and the negative pressure room 42. Here, the negative pressure room 42 was made to open for free passage here with the inlet pipe (throttle-valve lower stream of a river) of the engine which is not illustrated, for example, therefore predetermined negative pressure has always occurred during an engine drive at the negative pressure room 42. the tubed solenoid-valve linkage which a power piston 40 is equipped with the vacuum valve 43, a breather valve 44, and a solenoid valve 45, and is stroked by excitation of this solenoid valve to the left in drawing -- it has the operation rating rod 46 interlocked with a member 47 and brake ** dull operation Moreover, as shown in drawing 2 , return springs 53a and 53b, a diaphragm return spring 55, and spring 56 grade are incorporated.
[0036] The case where it will be in the same negative pressure state as the negative pressure room 42 through the negative pressure path 51 of a power piston 40, and in the case of the state of air opening, the transformation room 41 is switched. A change is performed by opening and closing of the vacuum valve 43 and a breather valve 44 (atmospheric pressure path section). A part for the valve portion by the side of the vacuum valve 43 which the opening part of the negative pressure path 51 counters with this like illustration like the state of drawing 2 (among drawing) It is in the state (vacuum valve-opening) where the up part of the tubed valve element which made return spring 53a intervene between the right end sections of a member 47 separates from it being considerable, and is opened wide. according to and the energization force of return springs 53a and 53b illustration -- like -- the above-mentioned solenoid-valve linkage -- the valve seat 52 of the breather valve 44 prepared in the member 47 in the state (breather-valve close) where sat down in the atmospheric pressure path section (the lower part in drawing of the above-mentioned tubed valve element is considerable) by the side of the atmosphere, and this is shut Negative pressure is led to the transformation room 41 from the negative pressure room 42, therefore, as for the transformation room 41, the negative pressure room 42 and the pressure balance in the state of negative pressure. Both loculus are in this state at the time of brake un-operating.
[0037] A deer is carried out, the atmosphere is introduced at the time of a brake operation, differential pressure with the negative pressure room 42 arises in the transformation room 41, and the load which doubled the power to the master cylinder 26 is transmitted to it. namely, brake ** -- dull -- the solenoid-valve linkage which supports return spring 53a in connection with the operation rating rod 46 being pushed in into a power piston 40 at the time of treading in of 21 -- if a member 47 moves only a predetermined stroke to the left in drawing to a power piston 40, according to the elastic stability of return spring 53a, the above-mentioned tubed valve element concerning the vacuum valve 43 and a breather valve 44 will ****, and it will come to close the negative pressure path 11 in the position [ begin ] which this negative pressure path 11 closes, the atmospheric pressure circulation space by the side of a breather valve 44 is still shut -- having -- **** -- from this position -- further -- solenoid-valve linkage -- solenoid-valve linkage if a member 47 ****, since the tubed valve element is unmovable any more in the state where it sat down to opening of the negative pressure path 11 -- the valve seat 52 of a member 47 will separate from the tubed valve element here, and an atmospheric pressure path will open

(vacuum valve-closing and breather-valve open) Atmospheric pressure is led to the transformation room 41 by this, and differential pressure arises in the negative pressure room 42 and the transformation room 41.

[0038] if such a change is performed by control of a solenoid valve 45 and drive current is supplied to a solenoid valve 45 -- the electromagnetic force -- solenoid-valve linkage -- while a member 47 resists a spring 56, is attracted leftward in drawing and closes the negative pressure path 11, it can shift to the position which makes an atmospheric pressure path open wide, and the same function as the above can be made to perform Therefore, in this example, the vacuum valve 43 is closed, when a brake pedal 21 strokes by the driver, or when this solenoid valve 45 excites, and it intercepts a free passage with the negative pressure room 42 and the transformation room 41. Moreover, a breather valve 44 is opened, when a brake pedal 21 strokes by the driver, or when this solenoid valve 45 excites, and the atmosphere is introduced into the transformation room 41. therefore, the time of a solenoid valve 45 being excited to the corresponding timing, when carrying out drive control of the solenoid valve 45 -- solenoid-valve linkage -- a member 47 strokes leftward in drawing and switching operation of the vacuum valve 43 and a breather valve 44 is performed Differential pressure arises between the negative pressure room 42 and the transformation room 41 by that cause, the force gets across to the bush rod 48 and a master cylinder 26 through a reaction disc 49, and a brake force (braking fluid pressure) occurs to each wheel 27. Thus, the negative pressure booster 25 of drawing 2 can perform brake assistance.

[0039] It returns to drawing 1 , and a brake assistant means can be constituted including this negative pressure booster 25, and the solenoid valve 45 in the negative pressure booster 25 is controlled by this example with the control unit (controller) 29 which performs brake assistant control. The signal from the brake stroke sensor 23, each sensor 28 which detects the rotational speed of each wheel 27, and laser radar sensor which it is attached for example, in vehicles front front grill, and can be used for detection of vehicles distance with front vehicles 31 grade is inputted into this control unit 29. Moreover, the signal from the G sensor 32 when it corresponds, before and after measuring the degree of acceleration and deceleration of the accelerator stroke sensor 22 and vehicles can be inputted.

[0040] The control unit 29 into which the information before and behind [ G ] an accelerator stroke, a brake stroke, wheel rotational speed, the distance between two cars, and vehicles etc. is inputted is constituted including a microcomputer, and can consist of a store circuit which stores the control program for the brake assistance performed in an input detector, a data-processing circuit (CPU), and this data-processing circuit, other control programs, the result of an operation, etc., an output circuit which outputs the control signal which drives solenoid valves (RAM, ROM, etc.) 45.

[0041] Although a control unit 29 can perform brake assistant control fundamentally on the occasion of brake assistant control based on input, such as a brake stroke, according to the control program which shows the example to drawing 7 with a flow chart when it is judged that it is urgent Furthermore, while detecting distance with the front detection object of self-vehicles, to make [ neither more nor less from a viewpoint of the consideration matter (b) of the specification beginning, and a (b) ] this effective Detect the car body speed of a self-vehicle, calculate relative velocity from this front distance and this self-vehicle speed, calculate a brake stopping distance (X1) from this relative velocity, and a buffer distance (X2) is further applied to this. When made into the threshold the sum (X1+X2=Xsum) of the brake stopping distance (X1) and buffer distance (X2) which were computed, it approached when the present distance between two cars was less from a threshold (Xsum), and it is judged as ****, it approaches in this way and it is judged as **** Drive control to the solenoid valve 45 of the above-mentioned negative pressure booster 25 is performed so that brake pressure higher than the brake pressure generated by the brakes operation of a driver may be given.

[0042] In this case, the buffer distance (X2) introduced to be added to a brake stopping distance (X1) is an adjustable controlled variable, preferably, shall compute a buffer distance (X2) from the self-vehicle speed, and computes and determines a control unit 29 in one of modes again. That is, as a flow chart shows the example to drawing 3 , from the state of a distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed (self-vehicle speed), a buffer distance (X2) is determined, or the distance average (Xave) between history empty vehicles of the

distance between two cars is computed, and it considers as the 1st mode determined according to this distance-between-two-cars average (Xave) at least. As a flow chart shows the example to drawing 4 , or from the history of the foot transfer time from an accelerator pedal 20 to a brake pedal 21 or [ considering as the 2nd mode which computes a mean time (Tave) and determines a buffer distance (X2) according to this mean time (Tave) at least ] -- or As a flow chart shows the example to drawing 5 , from the history of the vehicles order deceleration under braking [ whether it considers as the 3rd mode which computes average braking deceleration (Gave) and determines a buffer distance (X2) according to this average braking deceleration (Gave) at least, and ] or as the 4th mode which determines a buffer distance (X2) according to the size of three physical quantity, these distance-between-two-cars average (Xave), a mean time (Tave), and average braking deceleration (Gave) Processing for setting up the above-mentioned threshold (Xsum) from this buffer distance (X2) and above-mentioned brake stopping distance (X2) is also performed.

[0043] When using any one sort of three sorts of historical data mentioned above, any two sorts, or three sorts of all of those here, it is good for the memory of the store circuit in a control unit 29 to constitute including the non-volatile memory which accumulates the corresponding data in the time of the past run and which can carry out things.

[0044] In the following example programs, in the determination of a buffer distance (X2), and a setup The brake stopping distance which has shown the example which adopted the method by the 4th mode of the above which can perform this more finely, computes relative velocity from distance and the self-vehicle speed with a front detection object, and is computed from relative velocity (X1), The sum (Xsum) with the buffer distance (X2) computed from the self-vehicle speed is made into a threshold. In the case of composition of giving a pressure higher than the brake pressure which approaches when the actual distance between two cars is less from this threshold, judges to be Japanese cryptomeria, and is generated by the brakes operation of a driver Furthermore, specifically, a control unit 29 also performs processing according to the control program by each routine shown in each of drawing 3 , drawing 4 , drawing 5 , drawing 6 , and drawing 7 . And the foot-transfer-time mean time obtained from the history of the foot transfer time from an accelerator pedal 20 to a brake pedal 21 in this processing process (Tave), According to the size of three physical quantity of the distance-between-two-cars average (Xave) acquired from the history of the distance between two cars, and the average braking deceleration (Gave) obtained from the history of the deceleration of the vehicles under braking, as determining a buffer distance (X2) The peculiarity of a driver (owner-driver of the vehicles concerned) is made to grasp appropriately and certainly by monitoring any element of how to take pedal operation of a driver, vehicles information (braking G), and the distance between two cars continuously. By setting up the threshold (Xsum) of the distance between two cars corresponding to the property of the driver concerned, a dangerous situation is detected exactly and brake assistance is carried out.

[0045] Drawing 3 - drawing 7 are flow charts which show data processing of a control unit 29. This routine is an interrupt handler performed a predetermined period (it considers, for example as the period which flows once to 10msec(s) in this example).

[0046] Steps S100-S110 ( drawing 3 ) are the study routines of the distance-between-two-cars average at the time of a usual run. First, in Step S100, the vehicle speed (self-vehicle speed) is read from the rotational speed of a wheel based on the detecting signal of a sensor 28 to detect the car body speed of a self-vehicle. Next, in Step S101, it is judged for the vehicle speed whether it is less than a set point ** predetermined value (km [ for example, / 5 //(h) ]). This finds whether it is at the time of a 1 fixed-speed run. Thus, it is judged to the setting vehicle speed of the after-mentioned [ the vehicle speed read at Step S101 ] whether it is almost equal. When equal, it progresses to henceforth [ Step S102 ] (when the answer of Step S101 is affirmation (Y)). When that is not right, the store (namely, renewal of the setting vehicle speed) of the vehicle speed present at Step S106 is carried out to the setting vehicle speed (when the answer of Step S101 is negative (N)), and it progresses to the routine after Step S200 ( drawing 4 ).

[0047] When the answer of Step S101 is affirmation, it can be concluded that it is in a 1 fixed-speed run state. in this case In Step S103 which increments the timer (for example, the 1st timer which consists of a rise counter) which manages the time for asking for one data of the distance between two cars at Step

S102, and continues The distance between two cars (X) is read based on the information from the laser radar sensor 31 that distance with the front vehicles as a front detection object of self-vehicles is detectable.

[0048] Next, at Step S104, it is judged whether it is that the time check by the 1st timer of the above carried out predetermined-time progress (deadline), when it passes, it progresses to the distance-between-two-cars calculation routine after Step S107, and when having not passed, the calculation is not carried out. When processing is advanced by the loop which passes through such step S103 ->S104 ->**, it has an interval for every step S103 execution, and reading by this step S103 is performed to the corresponding timing, and each reading data is memorized until it carries out this predetermined-time progress. Thereby, the distribution of the distance between two cars between the predetermined times concerned can be seen.

[0049] When the 1st timer passes the deadline of, the following processings are performed only at once. Although it makes to calculate the average of the distance between two cars into a fundamental content, in the case of this example program, the distance-between-two-cars calculation routine is constituted there including each processing of calculation (Step S109) of an average of the vehicle speed with distinction (Step S105) of being a low speed, calculation (Step S107) of the distance-between-two-cars average, calculation (Step S108) of the distance between two cars/vehicle speed, and old old distance between two cars/vehicle speed.

[0050] First, in Step S105, it is judged for the vehicle speed from the predetermined vehicle speed whether it is a low speed. Consequently, when an answer is in the low-speed state of under the predetermined vehicle speed in affirmation, Steps S107-S109 are skipped, only Step S110 (timer clearance) is performed, and when an answer is negative, Steps S107-S109 and processing of S110 are performed once to the timing. Therefore, the distance-between-two-cars calculation routine of Steps S107-S109 does not perform from a standpoint that it is not suitable for study of the distance-between-two-cars average at the time of a usual run from a viewpoint in this brake assistant control that a driver [ brakes operation ] will be assisted at the time of a low speed, i.e., a run state which is not filled with the time of a 1 fixed-speed run into the predetermined vehicle speed. Therefore, even when determining a buffer distance (X2) from the state of a distribution of the distance between two cars, as a result of making the distance-between-two-cars information at the time of the 1 fixed-speed run more than the predetermined vehicle speed with an object chiefly, although required sufficient suitable buffer distance is defined, it will become more exact and improvement in precision can be aimed at. Therefore, in the scene where Steps S107-S109 are skipped, as a result of not being set as the object of the accumulation as historical data, even when it is going to determine a buffer distance according to the distance-between-two-cars average acquired from the history of the distance between two cars, also about the part and the historical data to apply, the data based on the distance between two cars in the run state will become more exact, and can aim at improvement in precision again.

[0051] when a deer is carried out and the vehicle speed is judged to be more than the predetermined vehicle speed at Step S105, in Step S107, the value of the distance-between-two-cars data memorized between the above-mentioned predetermined times (Step S104) is equalized (this calculation value will be cut also with what [ exact ] has the few bias which does not have dispersion more if this is further used together with the past historical data), and it transposes to the numeric value according to the vehicle speed at Step S108 further at this example program Here, it has supposed that it asks for the distance between two cars/vehicle speed, and this means having transposed the above-mentioned average about the distance between two cars obtained this time to the value (average) of the distance between two cars per vehicle speed. In addition, you may make it use the inverse number, i.e., the vehicle speed/distance between two cars, of this in this case.

[0052] And in Step S109 following Step S108, the macro average is computed including the average data accumulated until now, the 1st timer is cleared at Step S110, and the routine of drawing 1 is ended. In this way, the value acquired at Step S109 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0053] It turns out what the distance between two cars the driver is having and running usually by the

above routine. Furthermore, in this example program, it is aimed above also at the history of the past distance between two cars. It can ask for an average thing from the history, and the peculiarity of the driver about the part and the distance between two cars can be grasped appropriately and certainly. The thing of a state with few biass about whether the driver is running with the distance between two cars of how much usually is obtained. As a result of reflecting this in a setup of a buffer distance X2, the approach threshold XL (Step S404) corresponding to the property about how to take the distance between two cars of the driver more effectively and the feature can be set up.

[0054] Steps S200-S210 ( drawing 4 ) are routines which compute the average of the foot transfer time from an accelerator pedal 20 to a brake pedal 21. First, in Step S200, when it is judged whether it gets into the accelerator pedal 20 based on the information from the accelerator stroke sensor 22 and it gets into it (accelerator-on), it progresses to the processing which passes through Steps S209 and S210, and when that is not right, it progresses to Step S201.

[0055] In the case of the ** dull **** operation to a brake pedal 21 from the accelerator pedal 20 by the driver, A flag set here at Step S209 is a control flag for processing so that one data (foot-transfer-time data) may be obtained per step on substitute, is set at this step S209, and is cleared at the below-mentioned step S209. Moreover, the timer cleared at Step S210 is a timer (for example, the 2nd timer which consists of a rise counter) used for the time check of foot transfer time. At the time under accelerator-on, the processing by the side of the above-mentioned step S209 and S210 is always chosen for a driver to prepare for the ** dull operation of releasing an accelerator pedal 20 next and breaking in a brake pedal 21, and prepare for the surveillance of the ****, and calculation of the foot transfer time at that time.

[0056] If an accelerator pedal 21 is released, Step S200 will change processing to Step S201 side. At this step S201, when it is judged based on the information from the brake stroke sensor 23 whether it gets into the brake pedal 21 and it does not get into the brake pedal 21 by the loop this time, the 2nd timer in which foot transfer time is shown at Step S208 is incremented, and this routine in a loop is ended this time. Thereby, according to the driver having separated the leg from the accelerator pedal 21, it starts and the thing of the time check of foot transfer time can be carried out.

[0057] Processing is further advanced to henceforth [ Step S202 ] to check the time which the timing which regarded as **** from an accelerator pedal 20 to a brake pedal 21 having been made by the driver when carrying out a deer, progressing to Step S201 from Step S200 next time after a loop and coming to get into a brake pedal 21 (brake-on), and the answer of this step S201 converted into negative from affirmation took for the ****.

[0058] When getting into the brake pedal 21, first, it is Step S202 and it is judged whether the above-mentioned A flag for restricting to one data per step on substitute is set (that is, was the average of foot transfer time already computed like the after-mentioned or not?). Since the A flag concerned is in a set state by Step S209 by the loop of the beginning immediately after making the above-mentioned **** here, by the loop of the beginning of the immediately after concerned, Step S202 performs processing not more than step S203 only at once. And as a result of performing Step S207 (A flag clearance) at once then, as that to which calculation was already carried out, this routine is ended from Step S202 in that case, and, henceforth [ the following loop ], it progresses to the routine after Step S300.

[0059] Although it makes into a fundamental content for the data about foot transfer time to ask for the time taken at above **** here with the timer value of the 2nd timer Furthermore, distinction of whether in the case of this example program, this timer value is more than over the predetermined time (for example, 1 second) (Step S203), It constitutes including each processing of calculation (Step S205) of the set (Step S204) to the foot transfer time of a timer value, and the average with old foot transfer time.

[0060] First, in Step S203, it is judged whether the 2nd timer in which foot transfer time is shown passed 1 second or more. Consequently, when an answer is judged that 1 second or more passed by affirmation, it excepts from calculation of the average and skips to Step S206 (timer clearance), only this step S206 and Step S207 (A flag clearance) are performed, and when an answer is negative, processing of Steps S204 and S205 is performed once under the conditions below timer 1 second. Therefore, in the case of the state of **** from the accelerator pedal 20 with which the 2nd timer value for the time check of foot

transfer time passes 1 seconds or more to a brake pedal 21 From it not being suitable as foot transfer time from a viewpoint how much ** dull **** of time the driver has required in the brakes operation in the time of a usual run even if -- an accelerator pedal 21 -- releasing -- and after that brake * -- dull -- a series of operations of breaking in 22 were performed -- an imitation -- it can avoid adopting such foot-transfer-time data in this example therefore, the time concerning **** in ** dull operation -- taking into consideration -- a buffer distance -- a law -- foot-transfer-time information even when considering as a way, in case foot transfer time is less than a predetermined time (this example 1 second) chiefly -- an object -- it can do -- the need -- although sufficient suitable buffer distance (X2) is defined, it will become more exact and improvement in precision can be aimed at Moreover, the set to the foot transfer time by processing at Step S204 is not carried out, either, but there is no 2nd timer value data in such a **** state, if it is the object of the accumulation also as historical data. a result -- brake ** from an accelerator pedal 21 -- dull -- even when it is going to determine a buffer distance according to the average of the foot transfer time acquired from the history of the foot transfer time of 22, from calculation of a mean time (Tave), also about a part to be excepted and the historical data to apply, the historical data to which foot transfer time exceeds a predetermined time will become more exact, and can aim at improvement in precision

[0061] A deer is carried out and as a result of judgment at Step S203, if the 2nd timer value is less than 1 second, the timer value concerned is set as foot transfer time at Step S204. And in continuing Step S205, the average including the foot transfer time accumulated until now is computed, the 2nd timer and A flag are cleared at Steps S206 and S207, and this routine is ended. In this way, the value acquired at Step S205 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0062] the above routine -- a driver -- brake ** from an accelerator pedal 21 -- dull -- in case **** is carried out to 22, it turns out how much foot transfer time is usually applied to it Furthermore, in this example program, it is aimed above also at the history of the past foot transfer time. It can ask for an average thing from the history, and the peculiarity of the driver about the part and foot transfer time can be grasped appropriately and certainly. The thing of a state with few biass about by how much foot transfer time the driver is carrying out ** dull operation usually is obtained. as a result of reflecting this in a setup of a buffer distance X2, the approach threshold XL (Step S404) which balanced the property about the ** dull operation for **** of the driver and the feature more effectively is set up -- things are made

[0063] Steps S300-S312 ( drawing 5 ) are routines which supervise the braking G which is the vehicles information relevant to brakes operation, and calculate average braking deceleration. first, in Step S300, when it is judged whether it gets into the brake pedal 21 based on the information from the brake stroke sensor 23 and you get into it (brake-on), progress to Step S301, and when that is not right, pass processing of Steps S311 and S312 -- the timer and G flag related to this routine are cleared, and it ends

[0064] The timer cleared at Step S311 here is a timer (for example, the 3rd timer which consists of a rise counter) used in order to see the slowdown G of a predetermined time. Moreover, G flag is a control flag for processing so that one data may be adopted per [ by brake treading in ] slowdown. brake ** -- dull -- while 21 is not stepped on, Step S300 has always chosen the processing by the side of the above-mentioned step S311 and S312 to prepare for calculation of the deceleration under the braking when a driver next broke in and brakes a brake pedal 21

[0065] If it gets into a brake pedal 21, Step S300 will change processing to Step S301 side during the brake treading in concerned henceforth. At Step S301, it is judged whether G flag for adopting one data per [ by brake treading in ] slowdown is set. Although a routine is ended from this step S301 here when set (i.e., when it was already under braking this time and slowdown data storage is performed) By the loop of the beginning immediately after making treading in to the above-mentioned brake pedal 21 From it being in the change state by Step S312, first these G flags by the loop of the beginning of the immediately after concerned Step S301 will choose less than [ step S302 ], processing will be advanced, and processing which passes through Step S302 or subsequent ones is performed until the distinction result in the step S301 converts henceforth, when progressing to Step S301 from Step S300.

[0066] That is, when G flag is not set, at Step S302, reading of Slowdown G is performed based on the information from every this step S302 execution and the order G sensor 32. thereby -- brake ** -- dull -- the slowdown G of vehicles is always supervised during vehicles braking accompanying treading in of 21 Next, in Step S303, it is judged for the read slowdown G whether it is less than a set point predetermined value (for example, 0.05G). This finds whether predetermined within the limits has the slowdown G at that time. Thus, it is judged, when equal, it progresses to henceforth [ Step S304 ], and whether the slowdown G serially read at Step S302 is almost equal to the set point updates the set point at Step S310, when that is not right, and it ends this routine from this step S310, and progresses to the routine after Step S400 ( drawing 6 ).

[0067] When the answer of Step S303 is affirmation, it can conclude that the vehicles deceleration under brake treading in by the driver is within the limits of predetermined, and it is judged at Step S304 in this case whether it is that incremented the 3rd timer for seeing the average of the slowdown G of a predetermined time, and the time check by the timer carried out predetermined-time progress in continuing Step S305 (deadline). Thereby, it is judged whether calculation of an average of Slowdown G is possible. And Steps S306-S309 are skipped until the 3rd timer passes the deadline of, and this routine is ended. Thus, reading by every step S302 execution and this step S302 is performed, and each reading data can be memorized until this predetermined time passes, when processing is advanced by the loop which passes through step S302 ->S303 ->S304 ->S305 ->**. On the other hand, if this predetermined time passes and the 3rd timer passes the deadline of, it will progress to the processing after Step S306 to the timing.

[0068] It can use for the computation not more than step S306 for the information on the slowdown G when time for the slowdown G under brake treading in to be within the limits of predetermined carries out predetermined-time progress by this in this way. Here, processing not more than step S306 is performed only at once to adopt one data per the basis of such conditions, and slowdown. Although it makes to calculate the average of the slowdown G in this case into fundamental contents there, it constitutes from this example program including each processing of calculation (Step S306) of the average slowdown G, and calculation (Step S307) of the average with old average slowdown G data.

[0069] That is, in Step S306, the average of the slowdown G in the above-mentioned predetermined time (Step S305) is calculated. If this calculated value is relatively large here as for this as a result of being what is chiefly computed only under the above conditions, here, the part and its driver Can conclude that there are the inclination and the feature to which sudden braking is applied almost relatively, and if this calculated value is relatively small, the part and its driver it can be concluded that there are the inclination and the feature to which ****** is applied almost relatively (if this calculation value has such semantic attachment and this is further used together with the past historical data, it will cut this presumption also with what [ exact ] has the few bias which does not have dispersion more) And in Step S307, the macroscopic average is computed from the average accumulated until now, the change of G flag and the clear processing of the 3rd timer by Steps S308 and S308 are carried out after that, and this routine is ended. In this way, the value acquired at Step S307 is applied to a setup of the buffer distance X2 in Step S403 ( drawing 6 ) by this example program.

[0070] brake ** according to a driver at the above routine -- dull -- the deceleration of the average vehicles concerned produced usually is known during treading in of 21 Even when seeing the slowdown G between predetermined times, the slowdown G when time for the slowdown G under brake treading in to be within the limits of predetermined carries out predetermined-time progress chiefly can be used for calculation of the average, except it, as a result of being able to do the outside of an object, although required sufficient suitable buffer distance (X2) is defined, it will become more exact and improvement in precision can be aimed at in this brake assistant control. moreover, even when reading the slowdown G which the vehicles under braking produce, under conditions to which Steps S307 and S308 are skipped As a result of not being set as the object of the accumulation as historical data, even when it is going to determine a buffer distance according to the average braking deceleration obtained from the history of the deceleration of the vehicles under braking, also about the part and the historical data to apply, the data of the slowdown G will become more exact and can aim at improvement in precision.

[0071] In this example program, it is aimed above also at the history of the slowdown G of the vehicles under past braking. It can ask for an average thing from the history, and the peculiarity of the driver seen from the slowdown G under the part and brake treading in can be grasped appropriately and certainly. During braking by treading in of 21, take lessons from what braking G arises usually on vehicles, and the thing of a state with few biass is obtained. brake ** of a driver -- dull -- this can set up the approach threshold XL (Step S404) corresponding to the property about the generating braking G as the result reflected in a setup of a buffer distance X2, and vehicles information more effectively concerning the brakes operation of the driver, and the feature

[0072] Steps S400-S409 ( drawing 6 ) are routines which will set up the threshold that it is risk if it is related with the distance between two cars and approaches above, and set up the parameter of brake assistant control. First, in Step S400, the distance X between detection value empty vehicles of the laser radar sensor 31 is detected, and the relative velocity Vr (=dX/dt) with a front obstruction is calculated at Step S40. Furthermore, at Step S402, the physical stopping distance X1 (=Vr [2 ] / 2g) at the time of slowing down with a certain deceleration g is calculated.

[0073] Next, in Step S403, by this example program, the feature of a driver is presumed and a buffer distance X2 is set up from drawing 3 , drawing 4 , the average about the distance between two cars obtained by each routine (Step S100- S110, S200-S210, S300-S312) of drawing 5 , the foot-transfer-time average, and the slowdown G average. As this example, a relation as shown in the following table 1 is shown.

[0074]

[Table 1]

| 車間距離 | 踏替時間 | 制動 G | 運転者の特徴 | 余裕距離 |
|---|---|---|---|---|
| 大 | 大 | 大 | 安全志向、瞬発力高い、認知遅い | 大 |
| 大 | 大 | 小 | 安全志向、瞬発力高い、認知速い（熟練） | 中 |
| 大 | 小 | 大 | 安全志向、瞬発力低い、認知遅い（高齢・女性） | 大大 |
| 大 | 小 | 小 | 安全志向、瞬発力低い、認知速い | 大 |
| 小 | 大 | 大 | 接近派、瞬発力高い、認知遅い | 小 |
| 小 | 大 | 小 | 接近派、瞬発力高い、認知速い（せっかち派） | 小小 |
| 小 | 小 | 大 | 接近派、瞬発力低い、認知速い | 小 |
| 小 | 小 | 小 | 接近派、瞬発力低い、認知遅い | 中 |

[0075] Next, in Step S404, if it approaches more than this, the approach threshold XL that it is risk (it is less than the state; safety distance which passing approaches) will be computed. This setup was made into the sum of the stopping distance X1 which is physically rich, and the buffer distance X2 concerning cognition and ****. therefore, the stopping distance X1 as a brake stopping distance computed from relative velocity Vr in this example program and each above-mentioned average (the distance between two cars / vehicle speed average --) In continuing Step S405, by judging whether the actual distance between two cars X is larger than this threshold XL by making into a threshold the sum with the buffer distance X2 set up according to the foot-transfer-time average and three physical quantity of the average slowdown G When it approached when the distance between two cars X at that time was less from this threshold XL, and it can be judged as ****, it approaches and it is judged as ****, the brake assistance which gives brake pressure higher than the brake pressure generated by the brakes operation of a driver can be made to perform.

[0076] When it does in this way, appropriately as an adjustable controlled variable which applies a buffer distance X2 to the stopping distance X1 Determination, Can set up and the aggravation of a feeling depended for going into brake assistance frequently and being effective too much if it depends for the threshold of a safety distance on the composition defined uniquely, although the operation

pattern of a driver is various is caused. Or situations like -- the effect of original of a system fades conversely -- can also be avoided, the approach threshold XL corresponding to the property of the driver can be set up, correspondence nature can be raised, and the function of brake assistant control can be demonstrated appropriately the neither more nor less.

[0077] As illustrated to the above-mentioned table 1, when a buffer distance X2 is set up according to the size of three physical quantity, foot transfer time, the distance between two cars, and Braking G (slowdown G), in this case It is possible to grasp the peculiarity of the driver more appropriately and certainly by monitoring all of how to take ** dull operation of the driver, Braking G, and the distance between two cars continuously. In a setup of a buffer distance X2, this can be performed more finely, the feature of the driver concerned can be correctly presumed from all the field of them for any element, and the optimal buffer distance X2, therefore the optimal approach threshold XL can be set up.

[0078] The buffer distance X2 should respond to the distance between two cars, foot transfer time, and the combination of the size of three elements of Braking G here in Table 1. About distinction of the size of each element, the predetermined value for distinction about the foot-transfer-time average is established [ average / foot-transfer-time ], for example, and it is about whether it is beyond this predetermined value. Moreover, about the distance-between-two-cars average, the predetermined value for distinction about the distance-between-two-cars average is established, and it is about whether it is beyond this predetermined value. Moreover, about the slowdown G average, the predetermined value for distinction about the slowdown G average is established, and it is about whether it is beyond this predetermined value. the method of distinguishing size of ******** -- it can carry out -- therefore -- Table 1 -- the combination of this size -- as the feature of a driver -- the thing of the 1st column to the 8th column -- a case -- dividing -- carrying out -- having -- **** .

[0079] And about the buffer distance X2, the value of the buffer distance which should be added is assigned according to this. Five fields, "small smallness", "smallness", "inside", "size", and "size size", are classified, and each field is received here. in this order The value of a buffer distance respectively smaller than " as a predetermined value defined beforehand", Like "the value of a small buffer distance", "the value of the buffer distance of the degree of middle", and "big value" of a buffer distance and the value of a bigger buffer distance than "", the value of five sorts of buffer distances X2 can be set up, and it can set up finely.

[0080] In addition, even if this invention does not bar carrying out without using together all of these three elements, and each routine of drawing 3 , drawing 4 , and drawing 5 is independently used for it, respectively and it carries it out combining the routine of this drawing 6 and following drawing 7 , the mode which combines drawing 3 , drawing 4 , any two combination of each routine of drawing 5 , and the routine of this drawing 6 and following drawing 7 is sufficient as it.

[0081] Like previous statement in the aforementioned step S405, although it is the judgment step of distance-between-two-cars >XL, by this example program, the following processings are also further considered in less than [ step S405 ]. That is, the value of bus-available threshold which determines the timing which it is judged whether the actual distance between two cars is larger than the approach threshold XL, chooses the treading strength / the braking G property usual at Step S406 at Step S405 according to the result since it still is not dangerous when large, and starts the below-mentioned assistant control (Step S505) at continuing Step S408 is enlarged.

[0082] It is made easy for Braking G to become large to treading strength rather than usual at Step S407, to choose the property which strengthens effectiveness, to, make small the value of bus-available threshold which determines the timing which starts assistant control at Step S409 on the other hand, when [ with the actual distance between two cars smaller than the approach threshold XL ], namely, passing approaches, and to start brake assistant control.

[0083] Thus, as brake treading strength / a damping characteristic, two properties (Step S406), i.e., normal normal brake treading strength / damping characteristic, and the brake treading strength / damping characteristic of high gain (Step S407) are prepared beforehand, and it controls to change these alternatively and to make them apply according to the result of Step S405. Thus, as fluid-pressure gain over the brake input by the driver may be made high at the time of the brake assistance which gives

brake pressure higher than the brake pressure generated by the brakes operation of a driver when it approaches and is judged as ****, it can perform it, and it may consider this control. In this case, at the time of the brake assistance, rather than usual, the braking fluid pressure exceeding the brakes operation force more quickly can be started, and it can respond to brake assistance appropriately.

[0084] Steps S500-S508 ( drawing 7 ) are brake assistant control routines. first, the step S500 -- setting -- the detecting signal from the brake stroke sensor 23 -- being based -- brake * -- dull -- the amount of strokes of 21 is detected and brake stroke speed is computed from the variation of a predetermined time at the following step S501 thereby -- brake ** -- dull -- the brake input speed of the driver in process in which 21 is broken in is detectable as brake stroke speed

[0085] Continuing Step S502 is a step a brake pedal 21 judges it to be whether it is OFF (there is nothing brake ** dull **** rare ****). As a result of judgment at this step S502, in OFF, bus-available flag is cleared at Step S509, and it cancels assistant control. If bus-available flag enters at assistant conditions, and shows whether it is under [ control ] ******** and this flag is set here (Step S509), it is a flag meaning assistant being under control.

[0086] On the other hand, when getting into the brake pedal 21 as a result of judgment of Step S502 Furthermore, it is judged whether this bus-available flag that goes into assistant conditions and shows whether it is under [ control ] ******** in Step S503 is set. When assistant control is already started when set namely, it progresses to Step S505 (assistant control), and control is continued, and since when that is not right finds whether it is in the timing which should carry out assistant control, processing is advanced for Step S504.

[0087] At Step S504, it is judged whether brake stroke speed (Step S501) is larger than bus-available threshold. A judgment at this step S504 is for giving the predetermined assistant force, when the detection brake stroke speed in the brake ** dull 21 treading-in process of a driver exceeds rather than bus-available threshold by this. And at this example program, bus-available threshold used here is determined at the aforementioned steps S408 and S409 ( drawing 6 ). since [ therefore, ] it was judged that it approached too much in the aforementioned step S405 -- as the bus-available threshold -- smallness -- when bus-available threshold is chosen, this will be interlocked with, this bus-available threshold will be applied as a bus-available threshold for distinction at this step S504, and the judgment with brake stroke speed can be performed

[0088] As a result of a judgment at Step S504, when brake stroke speed is larger than bus-available threshold (i.e., when treading in with a brake is large), it presumes that it is urgent, and assistant control is performed at Step S505, and bus-available flag is set at Step S507. On the other hand, although assistant control is not performed as a result of a judgment when brake stroke speed is not larger than bus-available threshold (Step S506), it is Step S508 and treading strength and braking G feedback control are performed based on the defined gain in Step S504. What gain here was determined as at the aforementioned steps S406 and S407 ( drawing 6 ) is used.

[0089] In this way, once the answer of the step S504 is affirmed by the loop of step S502 ->S503 ->S504, brake assistant control will be started to the timing. As a concrete example which gives the predetermined assistant force to it when brake stroke speed exceeds here rather than bus-available threshold, in order to perform assistant control here at Step S504 A control unit 29 drives a solenoid valve 45 so that the vacuum valve 43 of the aforementioned negative pressure booster 25 of drawing 2 may serve as a closed position and a breather valve 44 may serve as an open position, by introducing the atmosphere into the transformation room 41, generates differential pressure with the negative pressure room 42, and generates a fluid pressure in a master cylinder 26 - a wheel cylinder. Therefore, thereby, assistant control is performed.

[0090] According to this brake assistant control as mentioned above, it can respond also to various operation patterns of a driver as if assistant control can be made to perform at the time of the brakes operation of a driver. By monitoring how taking ** dull operation of a driver, braking deceleration, and the distance between two cars continuously, in view of the property of the driver, the peculiarity of the driver concerned can be grasped, the approach threshold of the distance between two cars corresponding to the property of the driver concerned can be set up the more nearly optimal, and the state where

passing approaches exactly is detected, and for the driver concerned, a system can carry out brake assistance and becomes what has brake assistance more suitable for the driver concerned. This system also for a driver with the feature vacates the distance between two cars conversely also for a driver with the feature which packs and runs the distance between two cars, and it runs therefore, further Also for each driver which has the feature separately depending on how to apply pedal operation and braking from skillful degree age etc. The effect of having correspondence nature it being large, possible correspondence and high also in these drivers, and making them demonstrating the function of brake assistant control original appropriately the neither more nor less can be pulled out further.

[0091] As a concrete example of which assistant control is canceled at Steps S506 and S509 on the other hand, a solenoid valve 45 shall be driven and control shall be ended so that the vacuum valve 43 of the aforementioned negative pressure booster 25 may serve as an open position and a breather valve 44 may serve as a closed position. In addition, since the vacuum valve 43 serves as an open position and a breather valve 44 serves as a closed position by the energization force of a spring, intercepting energization of a solenoid valve 45 is also given to the purpose of a control end.

[0092] In addition, this invention is not limited to the form of the above operation. For example, although the buffer distance was gradually set up in the aforementioned table 1 when three physical quantity was used, this invention is not restricted to the method of setting up a buffer distance gradually such, and can be carried out also by the method of calculating the value of a synthetic buffer distance, by using these three physical quantity as reference data using the table and map which made property data memorize beforehand.

[0093] Moreover, it is a book, even if it uses brake treading strength, a brake fluid pressure, etc. not only instead of this but instead of brake stroke speed, although composition which performs assistant control is made into **-SU in the example of the above-mentioned control program for example, when brake stroke speed exceeds the threshold for the comparison.

[0094] moreover, the brake assistant method which performs assistant control which generates the predetermined damping force (braking fluid pressure) exceeding the brakes operation force of a driver is not the thing to depend on a negative pressure booster 25 like drawing 2 and which is restricted -- needless to say -- moreover, this invention -- electromagnetism -- it is widely applicable including the case where it is based on a brake system

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[Translation done.]

* NOTICES *



1. This document has been translated by computer.So the translation may not reflect the original precisely.
2. **** shows the word which can not be translated.
3.In the drawings, any words are not translated.

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## TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] A brake assistant system can expect that a stopping distance is shortened and an effect can be demonstrated at safety at improvement, if an operator [ brakes operation ] can be assisted in the scene where the operation of this system -- a forward vehicle carries out a quick stop -- should be needed. On the other hand, if its attention is paid to the operation pattern of the operator who will be assisted, it is various by a skillful grade, skillful age, etc. Moreover, even if, even if it is the operator of the same age and a skillful degree, it may become various also according to the difference of vehicles operation of an individual. When carrying out a deer and defining the threshold of the above-mentioned safety distance uniquely, the following points (problem) can be pointed out.

[0004] (b) Since an operator's operation pattern was not concerned variously but the threshold of a safety distance is defined uniquely, if a threshold is set up according to the property of the operator who maintains the average distance between two cars, since the above-mentioned auxiliary braking is started frequently, for an operator with the feature which packs and runs the distance between two cars, the aggravation of a feeling depended for being effective too much may be caused.

[0005] (b) If the distance between two cars sets a threshold to a small side on the contrary, for the operator who vacates and runs the distance between two cars, the opportunity of auxiliary braking will decrease and the effect of a system will fade.

[0006] Therefore, it is desirable as a brake assistant system to be also able to raise the correspondence nature from such a viewpoint, to demonstrate the function of original of brake assistant control appropriately the neither more nor less, and to make it get. Moreover, it is more desirable by enabling it to monitor how to take pedal operation of an operator, vehicles information (braking G), and the distance between two cars continuously that the situation that the system concerned should be operated exactly can be detected and brake assistance can be carried out by grasping the peculiarity of the operator concerned and setting up the threshold of the distance between two cars corresponding to the operator's property.

[0007] this invention will realize the brake assistant system in which is going to add an improvement from these points also based on the consideration described also below based on the above considerations, can also raise the correspondence nature from a viewpoint mentioned above, and excess and deficiency do not have, either, is made to demonstrate the function of brake assistant control original appropriately, and it deals. Moreover, a brake assistant system will be offered by supervising one or more [ of how to take ** dull operation of an operator, braking deceleration, and the distance between two cars ] at least, and grasping the peculiarity of the operator concerned.

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[Translation done.]

* NOTICES *



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MEANS

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[Means for Solving the Problem] The following brake assistant system is offered by this invention. That is, this invention is characterized by providing the following to a brake assistant system. A means to detect distance with the front detection object of self-vehicles. A means to detect the car body speed of a self-vehicle. A means to calculate relative velocity from this front distance and this self-vehicle speed. A means to calculate a brake stopping distance from this relative velocity, a means to compute the buffer distance added to this brake stopping distance, the means that makes a threshold the sum of the brake stopping distance and buffer distance which were computed, a means to judge that it approaches too much when the present distance between two cars is less from a threshold, and a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as ****.

[0009] Moreover, when computing a buffer distance from the self-vehicle speed, it is characterized by what the threshold of the distance between two cars corresponding to the property of the operator concerned is set up for by supervising one or more [ of how to take ** dull operation of an operator, vehicles information including braking deceleration, and the distance between two cars ].

[0010] Moreover, it is characterized by what a float is determined for according to this mean time including a means to compute a mean time, at least from the history of the foot transfer time from an accelerator pedal to a brake pedal.

[0011] Moreover, it is characterized by what a float is determined for from the history of the distance between two cars according to this distance-between-two-cars average including a means to compute the distance-between-two-cars average, at least.

[0012] Moreover, it is characterized by what a float is determined for from the history of the vehicles order deceleration under braking according to this average braking deceleration including a means to compute average braking deceleration, at least.

[0013] Moreover, it has further a means to compute a mean time from the history of the foot transfer time from an accelerator pedal to a brake pedal, a means to compute the distance average between history empty vehicles of the distance between two cars, and a means to compute average braking deceleration from the history of the vehicles order deceleration under braking, and is characterized by what a buffer distance is determined for according to the size of three physical quantity, these mean times, the distance-between-two-cars average, and average braking deceleration.

[0014] Moreover, small [ the distance-between-two-cars average ], when average braking deceleration is small, it is characterized by what the value of a buffer distance is set up for sufficiently more greatly than usual greatly [ the foot-transfer-time average ].

[0015] Moreover, greatly [ the distance-between-two-cars average ], when average braking deceleration is large, it is characterized by what the value of a buffer distance is set up for sufficiently smaller than usual small [ the foot-transfer-time average ].

[0016] Moreover, the historical data to which foot transfer time exceeds a predetermined time are characterized by what is excepted from calculation of a mean time.

[0017] Moreover, it is characterized by what a buffer distance is determined for from the state of a

distribution of the distance between two cars at the time of the 1 fixed-speed run more than the predetermined vehicle speed.
[0018] Moreover, it is characterized by what the distance between two cars / vehicle speed or the vehicle speed / distance between two cars is used for instead of the distribution of the distance between two cars.

[0019] Moreover, it is characterized by what vehicles deceleration when time for the vehicles deceleration under brake treading in to be within the limits of predetermined carries out predetermined-time progress is used for calculation of the average for.
[0020] Moreover, a brake assistant means to give brake pressure higher than the brake pressure generated by an operator's brakes operation when it approaches and is judged as **** is characterized by what fluid-pressure gain over the brake input by the operator is made high for.
[0021] Moreover, an operator's brake input speed is detected, and when it had further a means to give a predetermined pressure when input speed exceeded rather than a threshold, and approaches and is judged as ****, it is characterized by what the value of this threshold is made small for.
[0022] Moreover, an operator's brake input speed is detected, and when it had further a means to give a predetermined pressure when input speed exceeded rather than a threshold, and approaches and is judged as ****, it is characterized by what the value of the pressure to give is enlarged for.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] It is a whole block diagram concerning one example of the brake assistant system of this invention.
[Drawing 2] It is the block diagram of an example of an applicable negative pressure booster.
[Drawing 3] It is the flow chart which shows an example of data processing which a control unit performs, and is the program flowchart which shows the part.
[Drawing 4] It is drawing showing a part of the flow chart of other similarly.
[Drawing 5] Similarly, it is drawing showing a part of the flow chart of further others.
[Drawing 6] Similarly, it is drawing showing a part of the flow chart of further others.
[Drawing 7] Similarly, it is drawing showing a part of the flow chart of further others.
[Description of Notations]
20 Accelerator ** -- Dull
21 Brake ** -- Dull
22 Accelerator Stroke Sensor
23 Brake Stroke Sensor
25 Negative Pressure Booster
26 Master Cylinder
27 Wheel
28 Wheel Rotational-Speed Sensor
29 Control Unit (Controller)
31 Laser Radar Sensor
32 Vehicles Order G Sensor
41 Transformation Room
42 Negative Pressure Room
43 Vacuum Valve
44 Breather Valve
45 Solenoid Valve
46 Operation Rating Rod
47 Solenoid-Valve Linkage -- Member
48 Push Rod
49 Reaction Disc

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DRAWINGS

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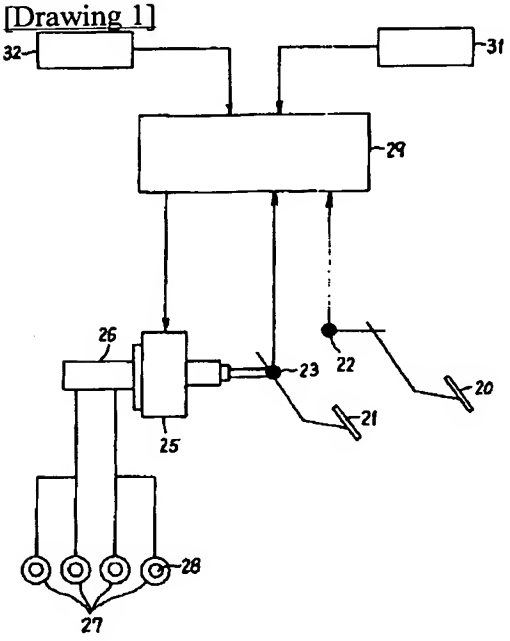
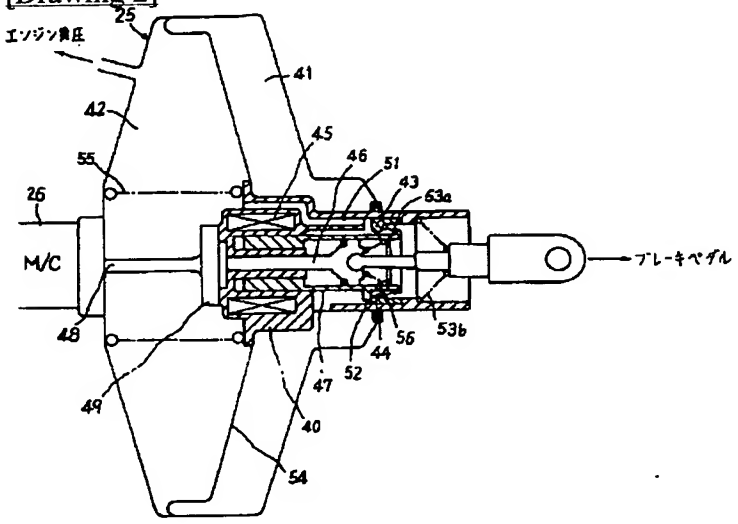
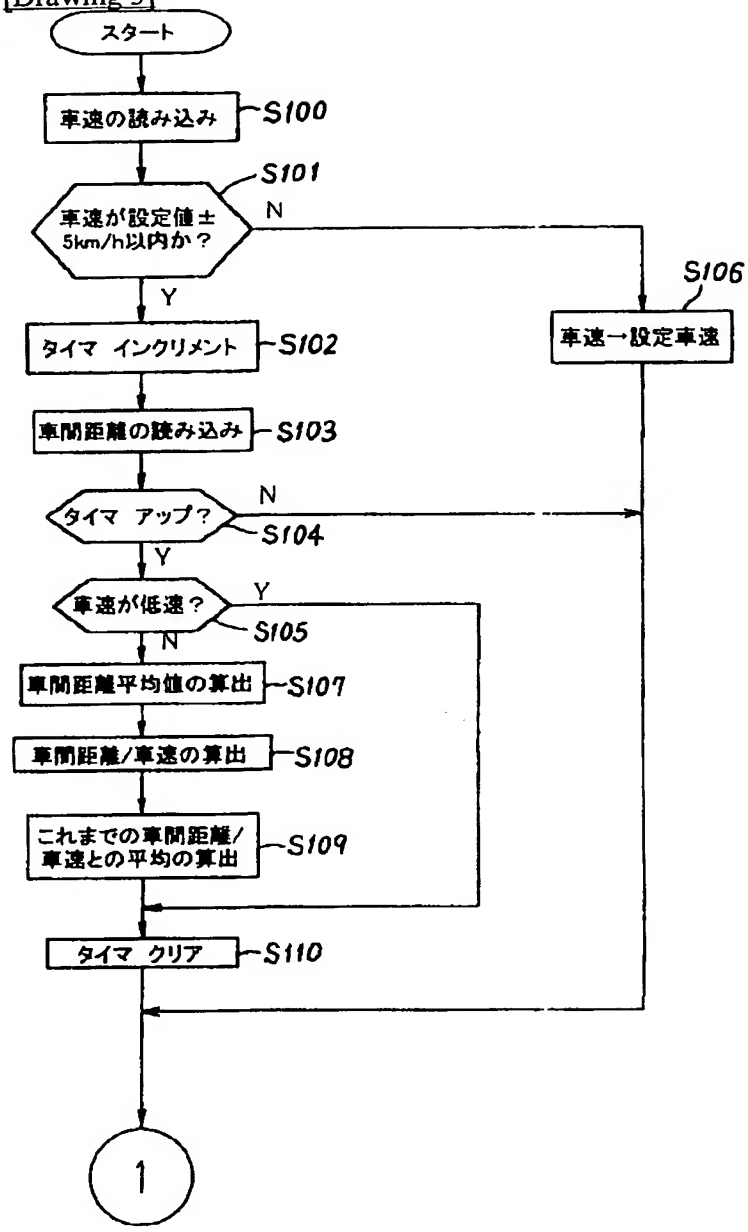
[Drawing 1]



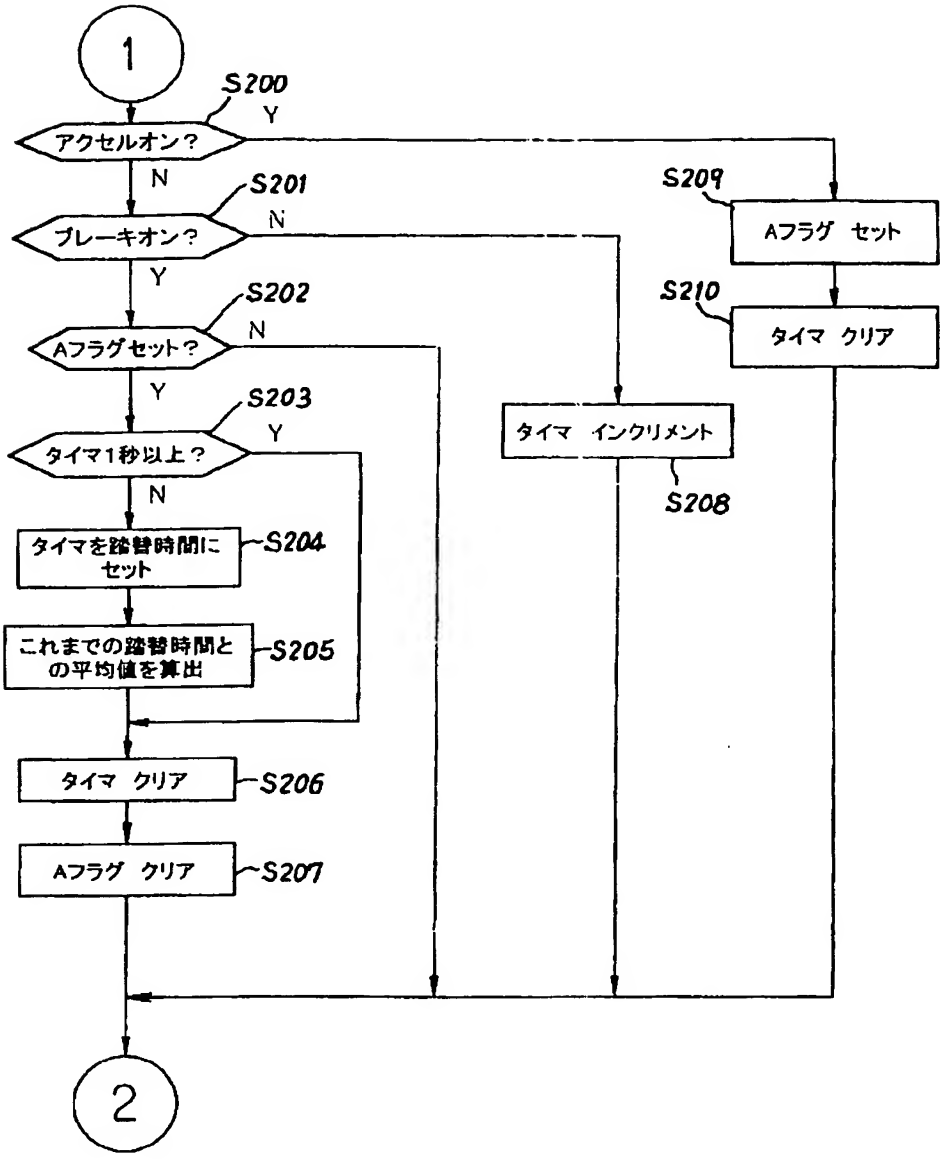

[Drawing 2]



[Drawing 3]




[Drawing 4]


1
S200
Y
アクセルオン？
N
S201
ブレーキオン？
N
Y
S202
Aフラグセット？
N
Y
S203
タイマ1秒以上？
Y
N
タイマを踏替時間にセット
S204
これまでの踏替時間との平均値を算出
S205
タイマ クリア
S206
Aフラグ クリア
S207
S209
Aフラグ セット
S210
タイマ クリア
タイマ インクリメント
S208
2

[Drawing 5]

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| B60R 21/00 | 620 | B60R 21/00 | 620Z |
| B60T 8/00 | | B60T 8/00 | Z |
| // G08G 1/16 | | G08G 1/16 | E |

審査請求　未請求　請求項の数15　ＯＬ　（全 22 頁）

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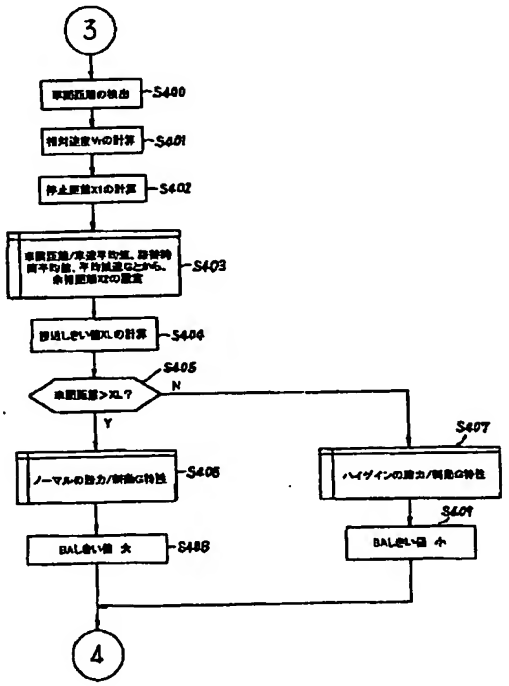
(54)【発明の名称】　ブレーキアシストシステム

(57)【要約】
【課題】　運転者の特性に見合った車間距離のしきい値を設定し、対応性を高め、過不足なくブレーキアシスト制御の機能を発揮させるシステムを提供する。
【解決手段】　例えば運転者のペダル操作、車両情報（制動Ｇ）、車間距離の取り方を常時監視し運転者のクセを把握する態様なら、前方検出物との距離と自車速から相対速度を算出し、相対速度から算出される制動距離（Ｘ１）と、余裕距離（Ｘ２）との和をしきい値とし、実際の車間距離がしきい値よりも下回ったときに接近しすぎと判断し、運転者のブレーキ操作によって発生するブレーキ圧よりも高い圧力を付与する構成とする場合において、アクセルペダルからブレーキペダルへの踏替時間の履歴から得られる平均時間と、車間距離の履歴から得られる車間距離平均値と、制動中の車両の減速度の履歴から得られる平均減速度との３つの物理量の大きさに応じて、余裕距離を決定する。



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【特許請求の範囲】
【請求項１】　自車両の前方検出物との距離を検出する手段と、
自車の車体速を検出する手段と、
該前方距離と該自車速とから相対速度を計算する手段と、
該相対速度から制動距離を計算する手段と、
該制動距離に対し加算する余裕距離を算出する手段と、
算出された制動距離と余裕距離との和をしきい値とする手段と、
現在の車間距離がしきい値よりも下回ったときに接近し過ぎると判断する手段と、
接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段とを有することを特徴とするブレーキアシストシステム。
【請求項２】　自車速から余裕距離を算出する場合において、運転者のペダル操作、制動減速度を含む車両情報、車間距離の取り方の一以上を監視することによって、当該運転者の特性に見合った車間距離のしきい値を設定する、ことを特徴とする請求項１記載のブレーキアシストシステム。
【請求項３】　請求項１、または請求項２において、
アクセルペダルからブレーキペダルへの踏替時間の履歴から、平均時間を算出する手段を含み、少なくとも該平均時間に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。
【請求項４】　請求項１、または請求項２において、
車間距離の履歴から、車間距離平均値を算出する手段を含み、少なくとも該車間距離平均値に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。
【請求項５】　請求項１、または請求項２において、
制動中の車両の前後減速度の履歴から、平均減速度を算出する手段を含み、少なくとも該平均減速度に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。
【請求項６】　請求項１、または請求項２において、
アクセルペダルからブレーキペダルへの踏替時間の履歴から平均時間を算出する手段と、車間距離の履歴から車間距離平均値を算出する手段と、制動中の車両の前後減速度の履歴から平均減速度を算出する手段とを更に有し、
これら平均時間と車間距離平均値と平均減速度の３つの物理量の大きさに応じて余裕距離を決定する、ことを特徴とするブレーキアシストシステム。
【請求項７】　請求項６において、
踏替時間平均値が大きく、かつ車間距離平均値が小さく、かつ平均減速度が小さいときは、余裕距離の値は通常よりも十分大きく設定する、ことを特徴とするブレーキアシストシステム。

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【請求項８】　請求項６において、
踏替時間平均値が小さく、かつ車間距離平均値が大きく、かつ平均減速度が大きいときは、余裕距離の値は通常よりも十分小さく設定する、ことを特徴とするブレーキアシストシステム。
【請求項９】　請求項３、請求項６、請求項７、または請求項８のいずれかにおいて、
踏替時間が所定時間を超える履歴データは、平均時間の算出からは除外する、ことを特徴とするブレーキアシストシステム。
【請求項１０】　請求項１ないし請求項９のいずれかにおいて、
所定車速以上の一定速走行時の車間距離の分布の状態から、余裕距離を決定する、ことを特徴とするブレーキアシストシステム。
【請求項１１】　請求項１０において、
車間距離の分布の代わりに、車間距離／車速、または車速／車間距離を用いる、ことを特徴とするブレーキアシストシステム。
【請求項１２】　請求項５、請求項６、請求項７、または請求項８のいずれかにおいて、
ブレーキ踏み込み中の車両減速度が所定の範囲内にある時間が所定時間経過したときの車両減速度を、平均値の計算に用いる、ことを特徴とするブレーキアシストシステム。
【請求項１３】　請求項１ないし請求項１２のいずれかにおいて、
接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段は、運転者によるブレーキ入力に対する液圧ゲインを高くする、ことを特徴とするブレーキアシストシステム。
【請求項１４】　請求項１ないし請求項１２のいずれかにおいて、
運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、
接近し過ぎと判断されたときに、該しきい値の値を小さくする、ことを特徴とするブレーキアシストシステム。
【請求項１５】　請求項１ないし請求項１２のいずれかにおいて、
運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、
接近し過ぎと判断されたときに、付与する圧力の値を大きくする、ことを特徴とするブレーキアシストシステム。
【発明の詳細な説明】
【０００１】

【発明の属する技術分野】本発明は、車両のブレーキアシストシステムに関するものである。

【０００２】

【従来の技術】ブレーキアシストシステムとして、例えば特公平４－２５１８２号公報（文献１）に記載されたものがある。文献１では、前方障害物との距離が安全距離を下回ったときに、運転者に危険を警報するとともに、ブレーキペダルの踏み込み時にブレーキ圧を補助制動する試みが提案されている。

【０００３】

【発明が解決しようとする課題】ブレーキアシストシステムは、例えば前方車が急停止するなど該システムの作動が必要とされるべき場面で運転者のブレーキ操作をアシストできると、停止距離を短縮し安全性に向上に効果を発揮できることが期待できる。一方、そのアシストされることとなる運転者の運転パターンに着目すれば、それは熟練の程度や年齢などによって様々である。また、たとえ同じ年齢、熟練の度合いの運転者であっても、個人個人の車両操縦の差によっても様々なものとなりうる。しかして、上記安全距離のしきい値を一義的に定める場合は、次のような点（問題）を指摘できる。

【０００４】（イ）運転者の運転パターンが様々にもかかわらず安全距離のしきい値を一義的に定めているため、平均的な車間距離を保つ運転者の特性に合わせてしきい値を設定すると、車間距離を詰めて走行する特徴を持つ運転者にとっては頻繁に上記補助制動に入ってしまうため、効きすぎによるフィーリングの悪化を招く可能性がある。

【０００５】（ロ）反対に、車間距離が小さい側にしきい値を設定すると、車間距離を空けて走行する運転者にとっては補助制動の機会が少なくなり、システムの効果が薄れる。

【０００６】したがって、ブレーキアシストシステムとして望ましいのは、こうした観点からの対応性をも高め得て、過不足なく、適切にブレーキアシスト制御の本来の機能を発揮させうるようにすることである。また、より望ましいのは、運転者のペダル操作、車両情報（制動Ｇ）、車間距離の取り方を常時監視できるようにすることによって当該運転者のクセを把握し、その運転者の特性に見合った車間距離のしきい値を設定することにより、的確に当該システムを作動させるべき状況を検出してブレーキアシストをすることができることである。

【０００７】本発明は、以上のような考察に基づき、また以下にも述べる考察にも基づき、これらの点から改善を加えようとするものであり、上述した観点からの対応性をも高め得て、過不足もなく、適切にブレーキアシスト制御本来の機能を発揮させうる、ブレーキアシストシステムを実現しようというものである。また、少なくとも、運転者のペダル操作、制動減速度、車間距離の取り方の一以上を監視し当該運転者のクセを把握することによって、当該運転者の特性に見合った車間距離のしきい値を設定し得て、ブレーキアシストが当該運転者にとって適切なものとなるようにすることのできる、ブレーキアシストシステムを提供しようというものである。



【０００８】

【課題を解決するための手段】本発明によって、下記のブレーキアシストシステムが提供される。すなわち、本発明のブレーキアシストシステムは、自車両の前方検出物との距離を検出する手段と、自車の車体速を検出する手段と、該前方距離と該自車速とから相対速度を計算する手段と、該相対速度から制動距離を計算する手段と、該制動距離に対し加算する余裕距離を算出する手段と、算出された制動距離と余裕距離との和をしきい値とする手段と、現在の車間距離がしきい値よりも下回ったときに接近し過ぎると判断する手段と、接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段とを有することを特徴とするものである。

【０００９】また、自車速から余裕距離を算出する場合において、運転者のペダル操作、制動減速度を含む車両情報、車間距離の取り方の一以上を監視することによって、当該運転者の特性に見合った車間距離のしきい値を設定する、ことを特徴とするものである。

【００１０】また、アクセルペダルからブレーキペダルへの踏替時間の履歴から、平均時間を算出する手段を含み、少なくとも該平均時間に応じて余裕時間を決定する、ことを特徴とするものである。

【００１１】また、車間距離の履歴から、車間距離平均値を算出する手段を含み、少なくとも該車間距離平均値に応じて余裕時間を決定する、ことを特徴とするものである。

【００１２】また、制動中の車両の前後減速度の履歴から、平均減速度を算出する手段を含み、少なくとも該平均減速度に応じて余裕時間を決定する、ことを特徴とするものである。

【００１３】また、アクセルペダルからブレーキペダルへの踏替時間の履歴から平均時間を算出する手段と、車間距離の履歴から車間距離平均値を算出する手段と、制動中の車両の前後減速度の履歴から平均減速度を算出する手段とを更に有し、これら平均時間と車間距離平均値と平均減速度の３つの物理量の大きさに応じて余裕距離を決定する、ことを特徴とするものである。

【００１４】また、踏替時間平均値が大きく、かつ車間距離平均値が小さく、かつ平均減速度が小さいときは、余裕距離の値は通常よりも十分大きく設定する、ことを特徴とするものである。

【００１５】また、踏替時間平均値が小さく、かつ車間距離平均値が大きく、かつ平均減速度が大きいときは、余裕距離の値は通常よりも十分小さく設定する、ことを特徴とするものである。

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【００１６】また、踏替時間が所定時間を超える履歴データは、平均時間の算出からは除外する、ことを特徴とするものである。

【００１７】また、所定車速以上の一定速走行時の車間距離の分布の状態から、余裕距離を決定する、ことを特徴とするものである。

【００１８】また、車間距離の分布の代わりに、車間距離／車速、または車速／車間距離を用いる、ことを特徴とするものである。

【００１９】また、ブレーキ踏み込み中の車両減速度が所定の範囲内にある時間が所定時間経過したときの車両減速度を、平均値の計算に用いる、ことを特徴とするものである。

【００２０】また、接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段は、運転者によるブレーキ入力に対する液圧ゲインを高くする、ことを特徴とするものである。

【００２１】また、運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、接近し過ぎと判断されたときに、該しきい値の値を小さくする、ことを特徴とするものである。

【００２２】また、運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、接近し過ぎと判断されたときに、付与する圧力の値を大きくする、ことを特徴とするものである。

【００２３】

【発明の効果】本発明によれば、上記構成により、請求項１記載の各手段のそれぞれを有して、運転者のブレーキ操作時、ブレーキアシスト制御を行わせることができるとともに、該ブレーキアシストをして前述の考察事項の観点から過不足なく効果的なものとせしめるべく、その余裕距離をその算出制動距離に適用する可変制御量として適切に決定、設定することを容易に可能ならしめる。よって、運転者の運転パターンが様々であるにもかかわらず安全距離のしきい値を一義的に定める構成によっては、頻繁にブレーキアシストに入ってしまうがゆえに効きすぎによるフィーリングの悪化を招き、あるいはシステムの本来の効果が薄れるなどするところ、本発明では、そのような事態を回避でき、運転者の特性に見合ったそのしきい値を設定し得て、対応性を高め、過不足もなく適切にブレーキアシスト制御の機能を発揮させうる、改良されたブレーキアシストシステムを実現することが可能となる。

【００２４】ここに、請求項２記載の如くに、そのしきい値を設定すると、その運転者のペダル操作、制動減速度、車間距離の取り方のいずれかもしくはすべての要素に合わせてしきい値設定を行える。したがって、これにより、当該運転者のクセを把握することによって、その分、当該運転者の特性に見合った車間距離のしきい値をより最適に設定することができ、当該運転者にとって、その運転者の特性からみて、的確に接近し過ぎの状態を検出してシステムがブレーキアシストをすることができ、ブレーキアシストが当該運転者にとってより適切なものとなるようにすることを可能ならしめる。

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【００２５】この場合において、その制動距離に加えられるべく適用される余裕距離については、例えば、請求項３ないし請求項５記載のように、少なくともそれぞれの算出手段を有して、アクセルペダルからブレーキペダルへの踏替時間の履歴から、平均時間を算出する手段からの該平均時間に応じて余裕時間を決定する態様か、または、車間距離の履歴から、車間距離平均値を算出する手段からの該車間距離平均値に応じて余裕時間を決定する態様か、または、制動中の車両の前後減速度の履歴から、平均減速度を算出する手段からの該平均減速度に応じて余裕時間を決定する態様かの、いずれかの態様による構成として、本発明は好適に実施でき、同様にして、上記のことを実現することができる。更に、これらの場合は、過去の該当する要素の履歴からその対応する平均的なものを求めることができ、その分、その運転者のクセを適切かつ確実に把握でき、例えば当該運転者が普段どの程度の車間距離をもって走行しているかについての偏りの少ない状態のものが得られ、これが余裕距離の設定に反映される結果、より効果的にその運転者の特性、特徴に見合ったしきい値を設定することができる。

【００２６】また、好ましくは、請求項６記載のように、それら踏替時間の平均時間と車間距離平均値と平均減速度の３つのすべての物理量の大きさに応じて余裕距離を決定する構成として本発明は好適に実施でき、同様にして、上記のことを実現することができる。加えて、この場合は、その運転者のペダル操作、制動減速度、車間距離の取り方のいずれも常時監視することによってその運転者のクセをより適切かつ確実に把握せしめること可能である。よって、余裕距離の設定、決定にあたり、これをよりきめ細かく行うことができ、その踏替時間に関する平均値、車間距離平均値、および平均減速度のいずれの要素をも対象として、それらすべての面から当該運転者の特徴を正確に推定して、最適な余裕距離、従って最適なしきい値を設定することができる。したがってまた、例えば、車間距離を詰めて走行する特徴をもつ運転者にとっても、逆に車間距離を空けて走行する特徴をもつ運転者にとっても、更には、熟練の度合い年齢などからペダル操作や制動のかけ方で個々に特徴をもつ運転者それぞれにとっても、それら運転者にも広く対応可能であって、高い対応性を有し、過不足なく適切にブレーキアシスト制御本来の機能を発揮させるという、上記の効果をより一層引き出すことができる。ここに、当該しきい値については、これ以上接近したら安全距離を下回

るという接近しきい値として、物理的にとまれる停止距離と、認知、踏替にかかる余裕距離の和からなる値として設定され得て、よくその機能を果たすものなる。

【００２７】また、踏替時間平均値、車間距離平均値、および平均減速度の物理量の大きさに応じて余裕距離を決定する場合において、請求項７または請求項８記載の如く、その余裕距離の値を設定する態様で本発明は好適に実施できる。この場合は、このようにすることで、踏替時間平均値、車間距離平均値、平均減速度の３つの物理量の大小の組み合わせに応じたものとすることができる。したがって、例えば、かかる大小の組み合わせにより、運転者の特徴として最大８種のものに場合分けも可能で、それに合わせて、上記加算されるべき余裕距離の値を割り当てられる。好適実施例によると、余裕距離の値は、これを、例えば、より小さい値、小さい値、中程度の値、大きな値、より大きな値というように設定可能で、その分、きめ細かく設定を行うことができる。もっとも、本発明は、このように段階的に余裕距離を設定する方法に限られるものではなく、例えばあらかじめ特性データを記憶させたテーブルやマップを用いて、これら３つの物理量を検索データとして、総合的な余裕距離の値を求める方法でも実施できるものである。

【００２８】また、本発明は、アクセルペダルからブレーキペダルへの踏替時間の履歴からその平均時間を算出する場合において、請求項９記載の如くに、踏替時間が所定時間を超える履歴データは、平均時間の算出からは除外する構成として、好適に実施できる。このようにすると、上記効果に加えて、たとえアクセルペダルを釈放しその後ブレーキペダルを踏み込むという一連のペダル操作が行われたにせよ、そのような所定時間を超える履歴データは踏替時間の平均時間の算出からは除外することができ、もっぱら踏替時間が所定時間を下回る場合の踏替時間情報を対象とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキアシスト制御の適正化を図ることができ、また、そのような踏替に要する時間が所定時間をも超えるようなアクセルペダルからブレーキペダルへの踏替の状態の時の踏替時間は履歴データとしても対象としないで済み、その踏替時間の履歴から得られる踏替時間平均値に応じて余裕距離を決定しようとする場合でも、その分、適用する踏替時間の履歴についても、より正確なものとなって、精度の向上が図れる。

【００２９】また、本発明においては、請求項１０記載のように、所定車速以上の一定速走行時の車間距離の分布の状態から、余裕距離を決定する構成とすることができる。このようにすると、上記効果に加えて、たとえ一定速走行時でも所定車速に満たないような低速走行状態で車間距離の情報を除外でき、もっぱら所定車速以上の一定速走行時の車間距離情報を対象とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキアシスト制御の適正化を図ることができる。また、そのような低速走行時の車間距離は履歴データとしても対象としないで済み、車間距離の履歴から得られる車間距離平均値に応じて余裕距離を決定しようとする場合でも、その分、適用する車間距離の履歴についても、より正確なものとなって、精度の向上が図れる。また、この場合において、請求項１１記載の如く、車間距離の分布の代わりに、車間距離／車速、または車速／車間距離を用いる構成としてもよく、同様にして上記のことを実現することができる。



【００３０】また、請求項１２記載の如くの構成として、本発明は好適に実施できる。このようにすると、上記効果に加えて、もっぱら、ブレーキ踏み込み中の車両減速度が所定の範囲内にある時間が所定時間経過したときの車両減速度を平均値の計算に用いることができ、それ以外は対象外とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキアシスト制御の適正化を図ることができ、また、上記条件以外の場合の車両減速度は履歴データとしても対象としないで済み、制動中の車両の減速度の履歴から得られる平均減速度に応じて余裕距離を決定しようとする場合でも、その分、適用する車両減速度の履歴についても、より正確なものとなって、精度の向上が図れる。

【００３１】また、請求項１３記載の如くに、接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段としては、これを、運転者によるブレーキ入力に対する液圧ゲインを高くする構成として好適に実施できる。この場合は、上記効果に加えて、ブレーキアシスト時、より迅速にブレーキ操作力を上回る制動液圧を立ち上げられて、アシスト圧を付与でき、適切にブレーキアシストに応えられ、この点で効果的なものとなり、本発明は、このような制御を加味して実施してもよい。

【００３２】また、請求項１４記載の如くに、運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段をもち、接近し過ぎと判断されたときに、該しきい値の値を小さくする態様の構成として、実施できる。この場合は、運転者のブレーキ入力速度に対する比較用のしきい値をも設けて、検出されるブレーキ入力速度とこれとを比較することで、その入力速度が該しきい値よりも上回ったときに所定の圧力を付与するようブレーキアシストをする方式の場合に好適に適用でき、車間距離が接近し過ぎと判断されるのに連動し、それに合わせて、当該比較用のしきい値を小さくして、その検出ブレーキ入力速度との判定が行えることとなり、上記のようなブレーキアシスト方式のときは、本発明は、このような制御をも加味して実施することができる。あるいはまた、請求項１５記載の如くに、同様に、運転者のブレーキ入力速度を検出し、

入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段をもち、車間距離が接近し過ぎと判断されたときに、付与する圧力の値を大きくする態様の構成としてもよい。この場合も、上記のブレーキアシスト方式に適用して、本発明は好適に実施することができる。

【００３３】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づき説明する。図１，２は、本発明の一実施例を示す図で、図１は全体の構成図である。図１中、２０、２１は、それぞれ運転者（ドライバ）が操作するアクセルペダル、ブレーキペダルを示す。ブレーキペダル２１には、該ブレーキペダルの操作量を検出するブレーキストロークセンサ２３が設けられる。本実施例では、アクセルペダル２０には、該アクセルペダルの操作量を検出するアクセルストロークセンサ２２が設けられる。

【００３４】また、本実施例では、ブレーキペダル２１によるブレーキ操作に連動してブレーキ液圧を発生させるマスターシリンダ（Ｍ／Ｃ）２６を備え、該マスターシリンダで発生させたブレーキ液圧（制動力）を車両の各車輪２７のホイールシリンダ（Ｗ／Ｃ）に導きブレーキを作用させるようにするとともに、マスターシリンダ２６は、電磁弁を内蔵している負圧ブースタ２５を備える。かかる負圧ブースタ２５を有するマスターシリンダ２６は、ドライバによるブレーキペダル２１の踏み込み時、ブレーキペダル２１の踏み込み位置に応ずるブレーキ液圧を出力するが、後述の如く、該当するときは、負圧ブースタ２５によるアシストの下、ドライバのブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与することができ、したがって、ドライバの操作力を上回る制動力を発生させうる。

【００３５】図２は負圧ブースタの構成図であり、以下、これにより負圧ブースタ２５の構造の一例を説明する。負圧ブースタ２５は、パワーピストン４０とダイヤフラム５４によって仕切られる変圧室４１と負圧室４２とを有する。ここに、負圧室４２は、例えば図示しないエンジンの吸気管（スロットル弁下流）と連通させるものとし、したがって、負圧室４２にはエンジン駆動中は常に所定の負圧が発生している。パワーピストン４０は、真空弁４３、大気弁４４および電磁弁４５を備え、該電磁弁の励磁によっても図中左方へストロークされる筒状の電磁弁連動部材４７とブレーキペダル操作に連動するオペレーティングロッド４６とを有する。また、図２に示す如くに、リターンスプリング５３ａ，５３ｂ、ダイヤフラムリターンスプリング５５、スプリング５６等が組み込まれる。

【００３６】変圧室４１は、パワーピストン４０の負圧通路５１を通じて負圧室４２と同じ負圧状態となる場合と、大気開放の状態の場合とに切り換えられる。切換えは、真空弁４３および大気弁４４（大気圧通路部）の開閉で行われる。図２の状態の如く、負圧通路５１の開口



部箇所が、図示のようにこれと対向する真空弁４３側の弁部分（図中、部材４７の右端部との間にリターンスプリング５３ａを介在させた筒状弁体の上部箇所が相当）から離れて開放されている状態（真空弁開）であって、かつ、リターンスプリング５３ａ，５３ｂの付勢力により、図示のように上記電磁弁連動部材４７に設けた大気弁４４の弁座５２が大気側への大気圧通路部（上記筒状弁体の図中の下部箇所が相当）に着座してこれを閉ざしている状態（大気弁閉）では、変圧室４１には負圧室４２から負圧が導かれ、したがって、変圧室４１は、負圧状態で負圧室４２と圧力が釣り合っている。ブレーキ非作動時は、両室はかかる状態となっている。

【００３７】しかして、変圧室４１には、ブレーキ作動時には大気が導入され、負圧室４２との差圧が生じ、マスターシリンダ２６に倍力された荷重が伝達される。すなわち、ブレーキペダル２１の踏み込み時、オペレーティングロッド４６がパワーピストン４０の中に押し込まれるのに伴い、リターンスプリング５３ａを支持する電磁弁連動部材４７がパワーピストン４０に対して図中左方へ所定のストロークだけ移動すると、リターンスプリング５３ａの弾性復元力により、真空弁４３および大気弁４４に係る上述の筒状弁体が慴動して負圧通路１１を閉じるようになる。この負圧通路１１の閉じ始めの位置では大気弁４４側の大気圧通路部分はまだ閉ざされており、この位置からさらに電磁弁連動部材４７が左行すると、その筒状弁体は負圧通路１１の開口部に着座した状態でそれ以上は移動できないことから、電磁弁連動部材４７の弁座５２がここでその筒状弁体から離れて大気圧通路が開くことになる（真空弁閉および大気弁開）。これにより変圧室４１には大気圧が導かれ、負圧室４２と変圧室４１とに差圧が生じるのである。

【００３８】このような切換えは、電磁弁４５の制御によっても行われ、電磁弁４５に駆動電流を供給すると、その電磁力により電磁弁連動部材４７がスプリング５６に抗して図中左方向に吸引され、負圧通路１１を閉じるとともに大気圧通路を開放させる位置に移行し、上記と同様の機能を行わせることができる。したがって、本実施例において、真空弁４３は、ドライバによりブレーキペダル２１がストロークしたときあるいは該電磁弁４５が励磁したときに閉じ、負圧室４２と変圧室４１との連通を遮断する。また、大気弁４４は、ドライバによりブレーキペダル２１がストロークしたときあるいは該電磁弁４５が励磁したときに開き、変圧室４１に大気が導入される。よって、該当するタイミングで、電磁弁４５を駆動制御すれば、電磁弁４５が励磁された時電磁弁連動部材４７が図中左方向にストロークし、真空弁４３および大気弁４４の開閉操作が行われる。それにより負圧室４２と変圧室４１との間に差圧が生じ、リアクションディスク４９を介してプシュロッド４８およびマスターシリンダ２６に力が伝わり、各車輪２７に対してブレーキ

力（制動液圧）が発生する。このようにして、図２の負圧ブースタ２５によりブレーキアシストが行える。

【００３９】図１に戻り、本実施例では、ブレーキアシスト手段はかかる負圧ブースタ２５を含んで構成でき、その負圧ブースタ２５における電磁弁４５は、ブレーキアシスト制御を行う制御装置（コントローラ）２９により制御する。該制御装置２９には、ブレーキストロークセンサ２３、各車輪２７の回転速度を検出する各センサ２８、および例えば車両前方フロントグリルに取り付けられて前方車両との車両距離の検出に用いることのできるレーザレーダセンサ３１等からの信号を入力する。また、該当するときは、アクセルストロークセンサ２２、車両の加減速度を測定する前後Ｇセンサ３２からの信号を入力することができる。

【００４０】アクセルストローク、ブレーキストローク、車輪回転速度、車間距離、車両前後Ｇ等の情報が入力される制御装置２９は、マイクロコンピュータを含んで構成され、入力検出回路と、演算処理回路（ＣＰＵ）と、該演算処理回路で実行されるブレーキアシストのための制御プログラム及びその他の制御プログラム、並びに演算結果等を格納する記憶回路（ＲＡＭ，ＲＯＭ等）と、電磁弁４５を駆動する制御信号を出力する出力回路等から構成することができる。

【００４１】制御装置２９は、ブレーキアシスト制御に際しては、その一例を図７にフローチャートで示す制御プログラムに従い、ブレーキストローク等の入力情報に基づき、基本的に、緊急と判断される場合にブレーキアシスト制御を行うことができるが、更に、これを、明細書冒頭の考察事項（イ）、（ロ）の観点からも過不足なく効果的なものとするべく、自車両の前方検出物との距離を検出するとともに、自車の車体速を検出し、該前方距離と該自車速とから相対速度を計算して該相対速度から制動距離（Ｘ１）を計算し、これに更に余裕距離（Ｘ２）を適用して、算出された制動距離（Ｘ１）と余裕距離（Ｘ２）との和（Ｘ１＋Ｘ２＝Ｘｓｕｍ）をしきい値とし、現在の車間距離がしきい値（Ｘｓｕｍ）よりも下回った時に接近し過ぎと判断し、かくて接近し過ぎと判断されたときに、ドライバのブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するよう、上記負圧ブースタ２５の電磁弁４５に対する駆動制御を実行する。

【００４２】この場合において、制動距離（Ｘ１）に加算されるべく導入した余裕距離（Ｘ２）は、可変制御量であり、好ましくは、自車速から余裕距離（Ｘ２）を算出するものとし、より好ましくはまた、制御装置２９は、いずれかの態様で算出、決定する。すなわち、その一例を図３にフローチャートで示す如くに、所定車速（自車速）以上の一定速走行時の車間距離の分布の状態から、余裕距離（Ｘ２）を決定するか、および／または車間距離の履歴から車間距離平均値（Ｘａｖｅ）を算出し、少なくとも該車間距離平均値（Ｘａｖｅ）に応じて決定する第１の態様とする。もしくは、その一例を図４にフローチャートで示す如く、アクセルペダル２０からブレーキペダル２１への踏替時間の履歴から、平均時間（Ｔａｖｅ）を算出し、少なくとも該平均時間（Ｔａｖｅ）に応じて余裕距離（Ｘ２）を決定する第２の態様とするか、もしくは、その一例を図５にフローチャートで示す如く、制動中の車両の前後減速度の履歴から、平均減速度（Ｇａｖｅ）を算出し、少なくとも該平均減速度（Ｇａｖｅ）に応じて余裕距離（Ｘ２）を決定する第３の態様とするか、または、それら車間距離平均値（Ｘａｖｅ）と平均時間（Ｔａｖｅ）と平均減速度（Ｇａｖｅ）の３つの物理量の大きさに応じて余裕距離（Ｘ２）を決定する第４の態様として、かかる余裕距離（Ｘ２）と上記制動距離（Ｘ２）から上記しきい値（Ｘｓｕｍ）を設定するための処理をも実行する。

【００４３】ここに、上述した３種の履歴データのいずれか１種、またはいずれか２種、またはその３種のいずれをも用いる場合には、制御装置２９内の記憶回路のメモリには、過去の走行時での該当するデータを蓄積しておくことできる不揮発性メモリを含んで構成するとよい。

【００４４】以下のプログラム例では、余裕距離（Ｘ２）の決定、設定にあたっては、よりきめ細かくこれを行うことのできる上記第４の態様による方法を採用した例を示してあり、前方検出物との距離と自車速から相対速度を算出し、相対速度から算出される制動距離（Ｘ１）と、自車速から算出される余裕距離（Ｘ２）との和（Ｘｓｕｍ）をしきい値とし、実際の車間距離が該しきい値よりも下回ったときに接近しすぎと判断し、ドライバのブレーキ操作によって発生するブレーキ圧よりも高い圧力を付与する構成の場合において、更に、具体的には、制御装置２９は、図３、図４、図５、図６および図７のそれぞれに示す各ルーチンによる制御プログラムに従う処理をも実行する。そして、かかる処理過程において、アクセルペダル２０からブレーキペダル２１への踏替時間の履歴から得られる踏替時間平均時間（Ｔａｖｅ）と、車間距離の履歴から得られる車間距離平均値（Ｘａｖｅ）と、制動中の車両の減速度の履歴から得られる平均減速度（Ｇａｖｅ）との３つの物理量の大きさに応じて、余裕距離（Ｘ２）を決定することとして、ドライバのペダル操作、車両情報（制動Ｇ）、車間距離の取り方のいずれの要素をも常時監視することによってドライバ（当該車両のオーナードライバ）のクセを適切かつ確実に把握せしめ、当該ドライバの特性に見合った車間距離のしきい値（Ｘｓｕｍ）を設定することにより、的確に危険な状況を検出してブレーキアシストをする。

【００４５】図３～図７は、制御装置２９の演算処理を示すフローチャートである。このルーチンは所定周期（本実施例では、例えば１０ｍｓｅｃに１回流れる周期

とする）で実行される割り込み処理ルーチンである。

【００４６】ステップＳ１００～Ｓ１１０（図３）は、普段の走行時の車間距離平均値の学習ルーチンである。まず、ステップＳ１００において、自車の車体速を検出するべくセンサ２８の検出信号に基づき車輪の回転速度から車速（自車速）が読み込まれる。次に、ステップＳ１０１において、車速が、設定値±所定値（例えば、５ｋｍ／ｈ）以内か否かが判断される。これにより、一定速走行時にあるかどうかをみる。このように、ステップＳ１０１で読み込まれた車速が後述の設定車速に対してほぼ等しいかどうかが判定され、等しい場合（ステップＳ１０１の答が肯定（Ｙ）の場合）はステップＳ１０２以降へ進み、そうでない場合（ステップＳ１０１の答が否定（Ｎ）の場合）はステップＳ１０６で現在の車速を設定車速にストア（すなわち、設定車速の更新）し、ステップＳ２００以降（図４）のルーチンへ進む。

【００４７】ステップＳ１０１の答が肯定のときは、一定速走行状態にあるとみることができ、この場合は、ステップＳ１０２では、車間距離の１データを求めるための時間を管理するタイマ（例えば、アップカウンタからなる第１のタイマ）をインクリメントし、続くステップＳ１０３において、自車両の前方検出物としての前方車両との距離の検出を行えるレーザレーダセンサ３１からの情報に基づき車間距離（Ｘ）が読み込まれる。

【００４８】次に、ステップＳ１０４では、上記第１のタイマによる計時が所定時間経過した（タイムアップ）かどうかが判定され、経過した場合はステップＳ１０７以降の車間距離算出ルーチンへ進み、経過していない場合はその算出をしない。このようなステップＳ１０３→Ｓ１０４→①を経るループで処理が進められるときは、該所定時間経過するまでの間、ステップＳ１０３実行ごとの間隔をもって、該当するタイミングで本ステップＳ１０３による読み込みが行われ、それぞれの読み込みデータを記憶される。これにより、当該所定時間の間の車間距離の分布をみることができる。

【００４９】第１のタイマがタイムアップしたとき、以下の処理が一度だけ実行される。そこでは、車間距離の平均値を求めることを基本的内容とするが、本プログラム例の場合、車間距離算出ルーチンは、車速が低速か否かの判別（ステップＳ１０５）、車間距離平均値の算出（ステップＳ１０７）、車間距離／車速の算出（ステップＳ１０８）、これまでの車間距離／車速との平均の算出（ステップＳ１０９）の各処理を含んで構成してある。

【００５０】まず、ステップＳ１０５において、車速が所定車速より低速か否かが判断される。その結果、答が肯定で所定車速未満の低速状態であるときは、ステップＳ１０７～Ｓ１０９がスキップされてステップＳ１１０（タイマクリア）のみが実行され、答が否定の場合に、そのタイミングでステップＳ１０７～Ｓ１０９，Ｓ１１０の処理が１回実行される。したがって、低速のとき、すなわちたとえ一定速走行時でも所定車速に満たないような走行状態では、ドライバのブレーキ操作をアシストしようという本ブレーキアシスト制御における観点からは、普段の走行時の車間距離平均値の学習に適さないとの見地から、ステップＳ１０７～Ｓ１０９の車間距離算出ルーチンは実行しない。よって、車間距離の分布の状態から余裕距離（Ｘ２）を決定する場合でも、もっぱら所定車速以上の一定速走行時の車間距離情報を対象とできる結果、必要十分な適切な余裕距離を定めるのに、より正確なものとなり、精度の向上を図ることができる。したがってまた、ステップＳ１０７～Ｓ１０９がスキップされるような場面では、その走行状態での車間距離に基づくデータは履歴データとしても蓄積の対象とならない結果、車間距離の履歴から得られる車間距離平均値に応じて余裕距離を決定しようとする場合でも、その分、適用する履歴データについても、より正確なものとなって、精度の向上が図れる。

【００５１】しかして、ステップＳ１０５で車速が所定車速以上と判断されたとき、ステップＳ１０７では上記所定時間の間（ステップＳ１０４）に記憶された車間距離データの値を平均化し（該算出値は、更にこれを過去の履歴データと併用すれば、よりばらつきのない偏りの少ない正確なものとでもきる）、更に、本プログラム例では、ステップＳ１０８で車速に応じた数値に置き換える。ここでは、車間距離／車速を求めることとしてあり、これは、今回得られた車間距離に関する上記平均値を、車速当たりの車間距離の値（平均値）に置き換えたことを意味する。なお、この場合に、これの逆数、すなわち車速／車間距離を用いるようにしてもよい。

【００５２】そして、ステップＳ１０８に続くステップＳ１０９においては、これまでに蓄積された平均データを含んでマクロ平均値を算出し、ステップＳ１１０で第１のタイマをクリアして図１のルーチンを終了する。かくして、ステップＳ１０９で得られた値は、本プログラム例では、ステップＳ４０３（図６）での余裕距離Ｘ２の設定に適用される。

【００５３】以上のルーチンで、ドライバが普段どの程度の車間距離を持って走行しているかが分かる。更には、本プログラム例では、上記のようにして、過去の車間距離の履歴をも対象として、その履歴から平均的なものを求めることができ、その分、車間距離に関するそのドライバのクセを適切かつ確実に把握でき、ドライバが普段どの程度の車間距離をもって走行しているかについての偏りの少ない状態のものが得られ、これが余裕距離Ｘ２の設定に反映される結果、より効果的にそのドライバの車間距離の取り方に関する特性、特徴に見合った接近しきい値ＸＬ（ステップＳ４０４）を設定することができる。

【００５４】ステップＳ２００～Ｓ２１０（図４）は、

アクセルペダル２０からブレーキペダル２１への踏替時間の平均値を算出するルーチンである。まず、ステップＳ２００において、アクセルストロークセンサ２２からの情報に基づきアクセルペダル２０が踏み込まれているかどうかが判定され、踏み込まれている場合（アクセルオン）は、ステップＳ２０９，Ｓ２１０を経る処理へ進み、そうでない場合はステップＳ２０１へ進む。

【００５５】ここに、ステップＳ２０９でセットされるＡフラグは、ドライバによるアクセルペダル２０からブレーキペダル２１へのペダル踏替操作の際、１回の踏み替え当たりに１つのデータ（踏替時間データ）が得られるよう処理するための制御フラグであり、本ステップＳ２０９でセットされ、後述のステップＳ２０９でクリアされるものである。また、ステップＳ２１０でクリアされるタイマは、踏替時間の計時に用いられるタイマ（例えば、アップカウンタからなる第２のタイマ）である。アクセルオン中のときは、ドライバが、次にアクセルペダル２０を釈放しブレーキペダル２１を踏み込むそのペダル操作に備え、その踏替の監視およびその時の踏替時間の算出に備えるべく、常時、上記ステップＳ２０９，Ｓ２１０側の処理を選択している。

【００５６】アクセルペダル２１が釈放されると、ステップＳ２００は処理をステップＳ２０１側へ切替える。本ステップＳ２０１では、ブレーキストロークセンサ２３からの情報に基づき、ブレーキペダル２１が踏み込まれているかどうかが判定され、今回ループでブレーキペダル２１が踏み込まれていない場合は、ステップＳ２０８にて踏替時間を示す第２のタイマをインクリメントして、今回ループでのこのルーチンを終了する。これにより、ドライバがアクセルペダル２１から足を離したのに合わせて、踏替時間の計時を開始することできる。

【００５７】しかして、次回ループ以降、ステップＳ２００からステップＳ２０１へ進む場合において、ブレーキペダル２１が踏み込まれる（ブレーキオン）に至ったとき、ドライバによってアクセルペダル２０からブレーキペダル２１への踏替がなされたとみて、かかるステップＳ２０１の答が肯定から否定に転換したタイミングで、その踏替のために要した時間をチェックするべく、処理を更にステップＳ２０２以降へ進める。

【００５８】ブレーキペダル２１が踏み込まれている場合は、まず、ステップＳ２０２で、１回の踏み替え当たりに１つのデータに制限するための前述のＡフラグがセットされているかどうか（すなわち、後述のように既に踏替時間の平均値が算出されたかどうか）が判定される。ここに、上記踏替がなされた直後の最初のループでは、ステップＳ２０９によって当該Ａフラグはセット状態にあることから、当該直後の最初のループでは、ステップＳ２０２は、ステップＳ２０３以下の処理を一度だけ実行する。そして、その時、ステップＳ２０７（Ａフラグクリア）が一度実行される結果、その次のループ以降では、既に計算がされたものとして、その場合は、ステップＳ２０２からこのルーチンを終了し、ステップＳ３００以降のルーチンへ進む。



【００５９】ここに、踏替時間に関するデータは、上記の踏替にかかった時間を第２のタイマのタイマ値により求めることを基本的内容とするが、更に、本プログラム例の場合、該タイマ値が所定時間（例えば、１秒）以上を超えているか否かの判別（ステップＳ２０３）、タイマ値の踏替時間へのセット（ステップＳ２０４）、これまでの踏替時間との平均値の算出（ステップＳ２０５）の各処理を含んで構成してある。

【００６０】まず、ステップＳ２０３において、踏替時間を示す第２のタイマが１秒以上経過したかどうかが判定される。その結果、答が肯定で、１秒以上経過したと判断された場合は平均値の計算から除外してステップＳ２０６（タイマクリア）へスキップし、本ステップＳ２０６およびステップＳ２０７（Ａフラグクリア）のみが実行され、答が否定の場合に、タイマ１秒未満の条件のもとでステップＳ２０４，Ｓ２０５の処理が１回実行される。したがって、踏替時間の計時用の第２のタイマ値が１秒以上をも経過するようなアクセルペダル２０からブレーキペダル２１への踏替の状態の場合は、ドライバが普段の走行時でのブレーキ操作においてどの程度のペダル踏替の時間を要しているかという観点からの踏替時間としては適していないことから、たとえアクセルペダル２１を釈放し、そしてその後ブレーキペダル２２を踏み込むという一連の操作が行われたにせよ、本例では、そのような踏替時間データを採用しないようにすることができる。よって、ペダル操作での踏替にかかる時間を考慮して余裕距離を定めようとする場合でも、もっぱら踏替時間が所定時間（本例では、１秒）を下回る場合の踏替時間情報を対象とでき、必要十分な適切な余裕距離（Ｘ２）を定めるのに、より正確なものとなり、精度の向上を図ることができる。また、そのような踏替状態での第２のタイマ値データは、ステップＳ２０４での処理による踏替時間へのセットもされず履歴データとしても蓄積の対象ともならない。結果、アクセルペダル２１からブレーキペダル２２への踏替時間の履歴から得られる踏替時間の平均値に応じて余裕距離を決定しようとする場合でも、踏替時間が所定時間を超える履歴データは平均時間（Ｔａｖｅ）の算出からは除外される分、適用する履歴データについても、より正確なものとなって、精度の向上が図れる。

【００６１】しかして、ステップＳ２０３での判断の結果、第２のタイマ値が１秒未満なら、ステップＳ２０４で当該タイマ値を踏替時間としてセットする。そして、続くステップＳ２０５においては、これまでに蓄積された踏替時間を含んだ平均値を算出し、ステップＳ２０６およびＳ２０７で第２のタイマとＡフラグをクリアしてこのルーチンを終了する。かくして、ステップＳ２０５

で得られた値は、本プログラム例では、ステップＳ４０３（図６）での余裕距離Ｘ２の設定に適用される。

【００６２】以上のルーチンで、ドライバがアクセルペダル２１からブレーキペダル２２へ踏替をする際、普段それにどの程度の踏替時間をかけているかが分かる。更には、本プログラム例では、上記のようにして、過去の踏替時間の履歴をも対象として、その履歴から平均的なものを求めることができ、その分、踏替時間に関するそのドライバのクセを適切かつ確実に把握でき、ドライバが普段どの程度の踏替時間でペダル操作をしているかについての偏りの少ない状態のものが得られ、これが余裕距離Ｘ２の設定に反映される結果、より効果的にそのドライバの踏替のためのペダル操作に関する特性、特徴に見合った接近しきい値ＸＬ（ステップＳ４０４）を設定することができる。

【００６３】ステップＳ３００～Ｓ３１２（図５）は、ブレーキ操作に関連する車両情報である制動Ｇを監視し、平均減速度を計算するルーチンである。まず、ステップＳ３００において、ブレーキストロークセンサ２３からの情報に基づきブレーキペダル２１が踏み込まれているかどうかが判定され、踏み込まれている場合（ブレーキオン）は、ステップＳ３０１へ進み、そうでない場合はステップＳ３１１，Ｓ３１２の処理を経てこのルーチンに関係するタイマとＧフラグをクリアして終了する。

【００６４】ここに、ステップＳ３１１でクリアされるタイマは、所定時間の減速Ｇをみるため用いられるタイマ（例えば、アップカウンタからなる第３のタイマ）である。また、Ｇフラグは、ブレーキ踏み込みによる減速１回につき１データを採用するよう処理するための制御フラグである。ブレーキペダル２１が踏まれていない間は、ドライバが次にブレーキペダル２１を踏み込んで制動した場合におけるその制動中の減速度の算出に備えるべく、ステップＳ３００は、常時、上記ステップＳ３１１，Ｓ３１２側の処理を選択している。

【００６５】ブレーキペダル２１が踏み込まれると、ステップＳ３００は、以後、当該ブレーキ踏み込み中は、処理をステップＳ３０１側に切替える。ステップＳ３０１では、ブレーキ踏み込みによる減速１回につき１データを採用するためのＧフラグがセットされているかどうかが判定される。ここで、セットされている場合、すなわち既に今回制動中で減速データ格納が行われた場合は、本ステップＳ３０１からルーチンを終了するが、上記ブレーキペダル２１の踏み込みがなされた直後の最初のループでは、該Ｇフラグはステップ３１２による切替え状態にあることから、まず、当該直後の最初のループでは、ステップＳ３０１は、ステップＳ３０２以下を選択して処理を進めることとなり、以後、ステップＳ３００からステップＳ３０１へと進む場合において、そのステップＳ３０１での判別結果が転換するまで、ステップＳ３０２以降を経る処理が実行される。

【００６６】すなわち、Ｇフラグがセットされていない場合は、ステップＳ３０２では、本ステップＳ３０２実行ごと、前後Ｇセンサ３２からの情報に基づき減速Ｇの読み込みが行われる。これにより、ブレーキペダル２１の踏み込みに伴う車両制動中、常時、車両の減速Ｇが監視される。次に、ステップＳ３０３において、読み込まれた減速Ｇが、設定値±所定値（例えば、０．０５Ｇ）以内か否かが判断される。これにより、そのときの減速Ｇが所定範囲内にあるかどうかをみる。このように、ステップＳ３０２で逐次読み込まれた減速Ｇが設定値とほぼ等しいかどうかが判定され、等しい場合はステップＳ３０４以降へ進み、そうでない場合はステップＳ３１０で設定値の更新を行い、本ステップＳ３１０からこのルーチンを終了し、ステップＳ４００（図６）以降のルーチンへ進む。

【００６７】ステップＳ３０３の答が肯定のときは、ドライバによるブレーキ踏み込み中の車両減速度が所定の範囲内にあるとみることができ、この場合は、ステップＳ３０４では、所定時間の減速Ｇの平均をみるための第３のタイマをインクリメントし、続くステップＳ３０５において、そのタイマによる計時が所定時間経過した（タイムアップ）かどうかが判断される。これにより、減速Ｇの平均の計算が可能かどうかが判定される。そして、第３のタイマがタイムアップするまでの間は、ステップＳ３０６～Ｓ３０９をスキップして本ルーチンを終了する。このようにステップＳ３０２→Ｓ３０３→Ｓ３０４→Ｓ３０５→③を経るループで処理が進められるときは、該所定時間が経過するするまでの間、ステップＳ３０２実行ごと、本ステップＳ３０２による読み込みが行われ、それぞれの読み込みデータを記憶することができる。一方、該所定時間が経過し第３のタイマがタイムアップしたら、そのタイミングでステップＳ３０６以降の処理へ進む。

【００６８】かくして、これにより、ブレーキ踏み込み中の減速Ｇが所定の範囲内にある時間が所定時間経過した時の減速Ｇの情報を対象として、ステップＳ３０６以下での計算処理に用いるようにすることができる。ここで、ステップＳ３０６以下の処理は、このような条件のもと、減速１回につき１データを採用するべく、一度だけ実行される。そこでは、かかる場合の減速Ｇの平均値を求めることを基本的内容とするが、本プログラム例では、平均減速Ｇの算出（ステップＳ３０６）、これまでの平均減速Ｇデータとの平均値の算出（ステップＳ３０７）の各処理を含んで構成してある。

【００６９】すなわち、ステップＳ３０６において、上記所定時間中（ステップＳ３０５）の減速Ｇの平均値が計算される。ここに、これは、もっぱら上記のような条件のもとでのみ算出されるものである結果、該計算値が相対的に大きければ、その分、そのドライバは、ほぼ、

相対的に急制動をかける傾向、特徴があるとみることができ、該計算値が相対的に小さければ、その分、そのドライバは、ほぼ、相対的に緩制動をかける傾向、特徴があるとみることができる（該算出値は、このような意味付けを有し、更にこれを過去の履歴データと併用すれば、かかる推定を、よりばらつきのない偏りの少ない正確なものとでもきる）。そして、ステップＳ３０７においては、これまでに蓄積された平均値とからマクロ平均値を算出し、その後ステップＳ３０８，Ｓ３０８によるＧフラグの切替えと第３のタイマのクリア処理をしてこのルーチンを終了する。かくして、ステップＳ３０７で得られた値は、本プログラム例では、ステップＳ４０３（図６）での余裕距離Ｘ２の設定に適用される。

【００７０】以上のルーチンで、ドライバによるブレーキペダル２１の踏み込み中に普段生ずる平均的な当該車両の減速度が分かる。所定時間の間の減速Ｇをみるときでも、もっぱら、ブレーキ踏み込み中の減速Ｇが所定の範囲内にある時間が所定時間経過した時の減速Ｇを平均値の計算に用いることができ、それ以外は対象外とできる結果、本ブレーキアシスト制御において、必要十分な適切な余裕距離（Ｘ２）を定めるのに、より正確なものとなり、精度の向上を図ることができる。また、制動中の車両の生ずる減速Ｇを読み込む場合でも、ステップＳ３０７，Ｓ３０８がスキップされるような条件のもとでは、その減速Ｇのデータは履歴データとしても蓄積の対象とならない結果、制動中の車両の減速度の履歴から得られる平均減速度に応じて余裕距離を決定しようとする場合でも、その分、適用する履歴データについても、より正確なものとなって、精度の向上が図れる。

【００７１】本プログラム例では、上記のようにして、



過去の制動中の車両の減速Ｇの履歴をも対象として、その履歴から平均的なものを求めることができ、その分、ブレーキ踏み込み中の減速Ｇからみたそのドライバのクセを適切かつ確実に把握でき、ドライバのブレーキペダル２１の踏み込みによる制動中、車両に普段どの程度の制動Ｇが生ずるのかにつき偏りの少ない状態のものが得られ、これが余裕距離Ｘ２の設定に反映される結果、より効果的にそのドライバのブレーキ操作に係わる車両情報としての発生制動Ｇに関する特性、特徴に見合った接近しきい値ＸＬ（ステップＳ４０４）を設定することができる。

【００７２】ステップＳ４００～Ｓ４０９（図６）は、車間距離に関してこれ以上接近したら危険であるとのしきい値を設定し、ブレーキアシスト制御のパラメータを設定するルーチンである。まず、ステップＳ４００ではレーザレーダセンサ３１の検出値から車間距離Ｘが検出され、ステップＳ４０で前方障害物との相対速度Ｖｒ（＝ｄＸ／ｄｔ）が計算される。更に、ステップＳ４０２では、ある減速度ｇで減速した場合の物理的な停止距離Ｘ１（＝Ｖｒ$^2$／２ｇ）が計算される。

【００７３】次に、ステップＳ４０３において、本プログラム例では、図３，図４，図５の各ルーチン（ステップＳ１００～Ｓ１１０、Ｓ２００～Ｓ２１０、Ｓ３００～Ｓ３１２）で得られた車間距離に関する平均値、踏替時間平均値、減速Ｇ平均値とから、ドライバの特徴を推定し、余裕距離Ｘ２を設定する。この例として、下記表１に示すような関係を示す。

【００７４】

【表１】

| 車間距離 | 踏替時間 | 制動Ｇ | 運転者の特徴 | 余裕距離 |
|---|---|---|---|---|
| 大 | 大 | 大 | 安全志向、瞬発力高い、認知遅い | 大 |
| 大 | 大 | 小 | 安全志向、瞬発力高い、認知速い（熟練） | 中 |
| 大 | 小 | 大 | 安全志向、瞬発力低い、認知遅い（高齢・女性） | 大大 |
| 大 | 小 | 小 | 安全志向、瞬発力低い、認知速い | 大 |
| 小 | 大 | 大 | 接近派、瞬発力高い、認知遅い | 小 |
| 小 | 大 | 小 | 接近派、瞬発力高い、認知速い（せっかち派） | 小小 |
| 小 | 小 | 大 | 接近派、瞬発力低い、認知速い | 小 |
| 小 | 小 | 小 | 接近派、瞬発力低い、認知遅い | 中 |

【００７５】次に、ステップＳ４０４においては、これ以上接近したら危険である（接近しすぎの状態；安全距離を下回る）という接近しきい値ＸＬを算出する。この設定は、物理的にとまれる停止距離Ｘ１と、認知、踏替にかかる余裕距離Ｘ２の和とした。したがって、本プログラム例では、相対速度Ｖｒから算出される制動距離としての停止距離Ｘ１と上記各平均値（車間距離／車速平均値、踏替時間平均値、平均減速Ｇ）の３つの物理量に応じて設定される余裕距離Ｘ２との和をしきい値として、続くステップＳ４０５において、実際の車間距離Ｘが該しきい値ＸＬよりも大きいかどうかを判定することで、その時の車間距離Ｘが該しきい値ＸＬよりも下回った時に接近し過ぎと判断することができ、接近し過ぎと判断されたときに、ドライバのブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシストを行わせることができる。

【００７６】このようにすると、余裕距離Ｘ２をその停止距離Ｘ１に適用する可変制御量として適切に決定、設定することができ、ドライバの運転パターンが様々であるにもかかわらず安全距離のしきい値を一義的に定める構成に依存すると頻繁にブレーキアシストに入ってしまって効きすぎによるフィーリングの悪化を招き、あるいは逆にシステムの本来の効果が薄れるなどといったような事態も回避できるし、そのドライバの特性に見合ったその接近しきい値ＸＬを設定し、対応性を高め、過不足なく適切にブレーキアシスト制御の機能を発揮させることができる。

【００７７】上記表１に例示したように、踏替時間と車間距離と制動Ｇ（減速Ｇ）の３つの物理量の大きさに応じて余裕距離Ｘ２を設定すると、この場合は、そのドライバのペダル操作、制動Ｇ、車間距離の取り方のいずれも常時監視することによってそのドライバのクセをより適切かつ確実に把握すること可能で、余裕距離Ｘ２の設定にあたり、これをよりきめ細かく行うことができ、いずれの要素をも対象として、それらすべての面から当該ドライバの特徴を正確に推定して、最適な余裕距離Ｘ２、従って最適な接近しきい値ＸＬを設定することができる。

【００７８】ここに、表１では、余裕距離Ｘ２は、車間距離、踏替時間、制動Ｇの３つの要素の大小の組み合わせに応じたものとすることができる。各要素の大小の判別については、例えば、踏替時間平均値については踏替時間平均値に関する判別用の所定値を設けて該所定値以上かどうかで、また、車間距離平均値については車間距離平均値に関する判別用の所定値を設けて該所定値以上かどうかで、また、減速Ｇ平均値については減速Ｇ平均値に関する判別用の所定値を設けて該所定値以上かどうかで、ぞれぞれの大小の判別を行う方法とすることができ、したがって、表１では、かかる大小の組み合わせにより、ドライバの特徴として第１欄から第８欄のものに場合分けされている。

【００７９】そして、余裕距離Ｘ２については、これに合わせて、加算されるべき余裕距離の値を割り当ててある。ここでは、「小小」、「小」、「中」、「大」、「大大」の５つの領域を区分けし、各領域に対し、この順で、それぞれ、あらかじめ定められた、所定値としての「より小さい余裕距離の値」、「小さい余裕距離の値」、「中程度の余裕距離の値」、「大きな余裕距離の値」、「より大きな余裕距離の値」というように５種の余裕距離Ｘ２の値が設定可能で、きめ細かく設定を行うことができる。

【００８０】なお、本発明は、これら３つの要素をすべて併用せずに実施することを妨げるものではなく、図３、図４、図５の各ルーチンをそれぞれ単独で用いて、本図６および次の図７のルーチンと組み合わせて実施しても、また、図３、図４、図５の各ルーチンのいずれか二つの組み合わせと、本図６および次の図７のルーチンとを結合する態様でもよい。



【００８１】前記ステップＳ４０５は、既述のように、車間距離＞ＸＬの判断ステップであるが、本プログラム例では、更に、ステップＳ４０５以下において、次のような処理も加味してある。すなわち、ステップＳ４０５では、実際の車間距離が接近しきい値ＸＬよりも大きいかどうかが判定され、その結果に応じて、大きい場合はまだ危険でないことから、ステップＳ４０６で通常の踏力／制動Ｇ特性を選択し、続くステップＳ４０８で後述のアシスト制御（ステップＳ５０５）に入るタイミングを決定するＢＡしきい値の値を大きくする。

【００８２】一方、実際の車間距離が接近しきい値ＸＬよりも小さい場合、すなわち接近し過ぎの場合は、ステップＳ４０７で通常よりも踏力に対して制動Ｇが大きくなり効きを強める特性を選択し、ステップＳ４０９でアシスト制御に入るタイミングを決定するＢＡしきい値の値を小さくしてブレーキアシスト制御に入り易くする。

【００８３】このように、ブレーキ踏力／制動特性として、あらかじめ２つの特性、すなわちノーマルのブレーキ踏力／制動特性（ステップＳ４０６）と、ハイゲインのブレーキ踏力／制動特性（ステップＳ４０７）とを用意し、ステップＳ４０５の結果に応じて、これらを選択的に切替え適用させるよう制御する。このようにして、接近し過ぎと判断されたときに、ドライバのブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト時は、ドライバによるブレーキ入力に対する液圧ゲインを高くするようにして行うことができ、かかる制御を加味してもよい。この場合は、そのブレーキアシスト時、通常よりも、より迅速にブレーキ操作力を上回る制動液圧を立ち上げられ、適切にブレーキアシストに応えられる。

【００８４】ステップＳ５００～Ｓ５０８（図７）は、ブレーキアシスト制御ルーチンである。まず、ステップＳ５００において、ブレーキストロークセンサ２３からの検出信号に基づき、ブレーキペダル２１のストローク量が検出され、次のステップＳ５０１では、所定時間の変化量からブレーキストローク速度が算出される。これにより、ブレーキペダル２１を踏み込みつつある過程でのドライバのブレーキ入力速度をブレーキストローク速度として検出できる。

【００８５】続くステップＳ５０２は、ブレーキペダル２１がオフ（ブレーキペダルが踏まれていない）かどうかを判断するステップである。本ステップＳ５０２での判断の結果、オフの場合は、ステップＳ５０９でＢＡフラグをクリアし、アシスト制御を解除する。ここに、ＢＡフラグは、アシスト条件に入って制御中かどうかを示すものであり、該フラグがセット（ステップＳ５０９）されていれば、アシスト制御中であることを意味するフラグである。

【００８６】一方、ステップＳ５０２の判断の結果、ブレーキペダル２１が踏み込まれている場合は、更に、ステップＳ５０３において、アシスト条件に入って制御中かどうかを示す該ＢＡフラグがセットされているかどうかが判定され、セットされている場合、すなわち既にアシスト制御が開始されているときは、ステップＳ５０５（アシスト制御）へ進んで制御を継続し、そうでない場合は、アシスト制御をすべきタイミングにあるかどうかをみるため、ステップＳ５０４を処理を進める。

【００８７】ステップＳ５０４では、ブレーキストローク速度（ステップＳ５０１）がＢＡしきい値よりも大きいかどうかが判断される。本ステップＳ５０４での判定は、これによって、ドライバのブレーキペダル２１踏み込み過程での検出ブレーキストローク速度がＢＡしきい値よりも上回ったときに所定のアシスト力を付与しようとするためのものである。そして、本プログラム例では、ここで用いるＢＡしきい値は、前記ステップＳ４０８、Ｓ４０９（図６）で決定されたものである。したがって、前記ステップＳ４０５において接近し過ぎていると判断されたために、そのＢＡしきい値として、小なるＢＡしきい値が選択されているときは、これに連動して、該ＢＡしきい値が本ステップＳ５０４での判別用のＢＡしきい値として適用されて、ブレーキストローク速度との判定が行えることとなる。

【００８８】ステップＳ５０４での判定の結果、ブレーキストローク速度がＢＡしきい値よりも大きい場合、すなわちブレーキの踏み込みが大きい場合は緊急であると推定し、ステップＳ５０５でアシスト制御を行い、ステップＳ５０７でＢＡフラグをセットする。他方、ステップＳ５０４での判定の結果、ブレーキストローク速度がＢＡしきい値よりも大きくない場合は、アシスト制御を行わないが（ステップＳ５０６）、ステップＳ５０８で、定められたゲインに基づき踏力・制動Ｇフィードバック制御が行われる。ここでのゲインは、前記ステップＳ４０６、Ｓ４０７（図６）で決定されたものが用いられる。

【００８９】かくして、ステップＳ５０２→Ｓ５０３→Ｓ５０４のループで、そのステップＳ５０４の答が一旦肯定となると、そのタイミングでブレーキアシスト制御が開始される。ここに、ステップＳ５０４でアシスト制御を行うためブレーキストローク速度がＢＡしきい値よりも上回ったときに所定のアシスト力を付与する具体的な例としては、制御装置２９は、図２の前記負圧ブースタ２５の真空弁４３が閉位置、大気弁４４が開位置となるように電磁弁４５を駆動し、変圧室４１に大気を導入することにより負圧室４２との差圧を発生させてマスタシリンダ２６～ホイールシリンダで液圧を発生させる。したがって、これによりアシスト制御が行われる。

【００９０】上述のようにして、本ブレーキアシスト制御によれば、ドライバのブレーキ操作時、アシスト制御



を行わせることができるとともに、ドライバの様々な運転パターンにも応えられる。ドライバのペダル操作、制動減速度、車間距離の取り方を常時監視することによって、当該ドライバのクセを把握して、当該ドライバの特性に見合った車間距離の接近しきい値をより最適に設定することができ、当該ドライバにとり、そのドライバの特性からみて、的確に接近し過ぎの状態を検出してシステムがブレーキアシストをすることができ、ブレーキアシストが当該ドライバにとってより適切なものとなる。したがって、本システムは、例えば、車間距離を詰めて走行する特徴をもつドライバにとっても、逆に車間距離を空けて走行する特徴をもつドライバにとっても、更には、熟練の度合い年齢などからペダル操作や制動のかけ方で個々に特徴をもつドライバそれぞれにとっても、それらドライバにも広く対応可能であって、高い対応性を有し、過不足なく適切にブレーキアシスト制御本来の機能を発揮させる、その効果をより一層引き出すことができる。

【００９１】一方、ステップＳ５０６、Ｓ５０９でアシスト制御を解除する具体的な例としては、前記負圧ブースタ２５の真空弁４３が開位置、大気弁４４が閉位置となるように電磁弁４５を駆動して制御を終了するものとすることができる。なお、電磁弁４５の通電を遮断するだけでもスプリングの付勢力で真空弁４３が開位置、大気弁４４が閉位置となるため制御終了の目的は達せられる。

【００９２】なお、本発明は、以上の実施の形態に限定されるものではない。例えば、前記表１では、３つの物理量を用いる場合において段階的に余裕距離を設定したが、本発明は、そのように段階的に余裕距離を設定する方法に限られるものではなく、例えばあらかじめ特性データを記憶させたテーブルやマップを用いて、これら３つの物理量を検索データとして、総合的な余裕距離の値を求める方法でも実施できるものである。

【００９３】また、例えば、上記制御プログラムの例では、ブレーキストローク速度がその比較用のしきい値を越えた場合にアシスト制御を行う構成をベースとしているが、これに限らず、ブレーキストローク速度の代わりにブレーキ踏力、ブレーキ液圧等を使っても本発明の効果が成立するのはもちろんである。

【００９４】また、ドライバのブレーキ操作力を上回る所定の制動力（制動液圧）を発生させるアシスト制御を行うブレーキアシスト方式は、図２のような負圧ブースタ２５によるもの限られるものでないことはいうまでもなく、また、本発明は、電磁ブレーキシステムによる場合を含んで広く適用可能である。

【図面の簡単な説明】

【図１】本発明のブレーキアシストシステムの一実施例に係る全体構成図である。

【図２】適用できる負圧ブースタの一例の構成図であ

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る。

【図３】制御装置が実行する演算処理の一例を示すフローチャートであって、その一部を示すプログラムフローチャートである。

【図４】同じく、そのフローチャートの他の一部を示す図である。

【図５】同じく、そのフローチャートの更に他の一部を示す図である。

【図６】同じく、そのフローチャートの更に他の一部を示す図である。

【図７】同じく、そのフローチャートの更に他の一部を示す図である。

【符号の説明】

２０　アクセルペダル
２１　ブレーキペダル
２２　アクセルストロークセンサ
２３　ブレーキストロークセンサ

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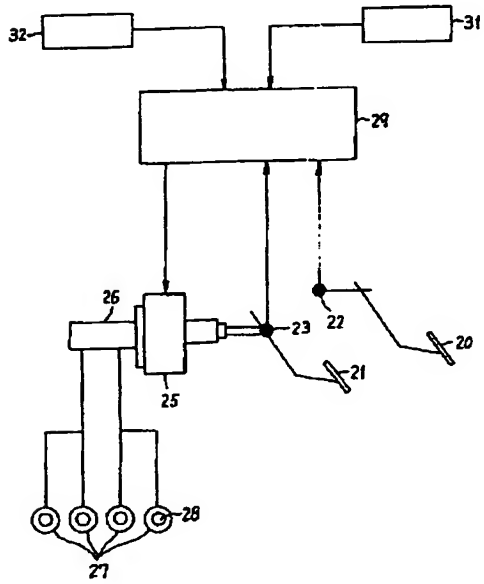
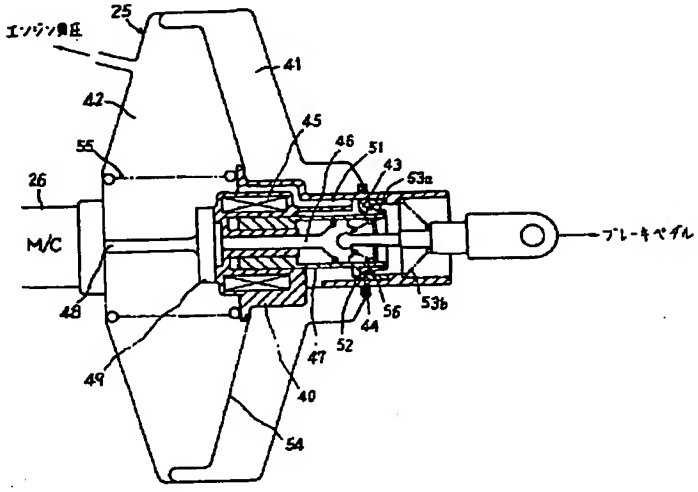
２５　負圧ブースタ
２６　マスターシリンダ
２７　車輪
２８　車輪回転速度センサ
２９　制御装置（コントローラ）
３１　レーザレーダセンサ
３２　車両前後Ｇセンサ
４１　変圧室
４２　負圧室
４３　真空弁
４４　大気弁
４５　電磁弁
４６　オペレーティングロッド
４７　電磁弁連動部材
４８　プッシュロッド
４９　リアクションディスク

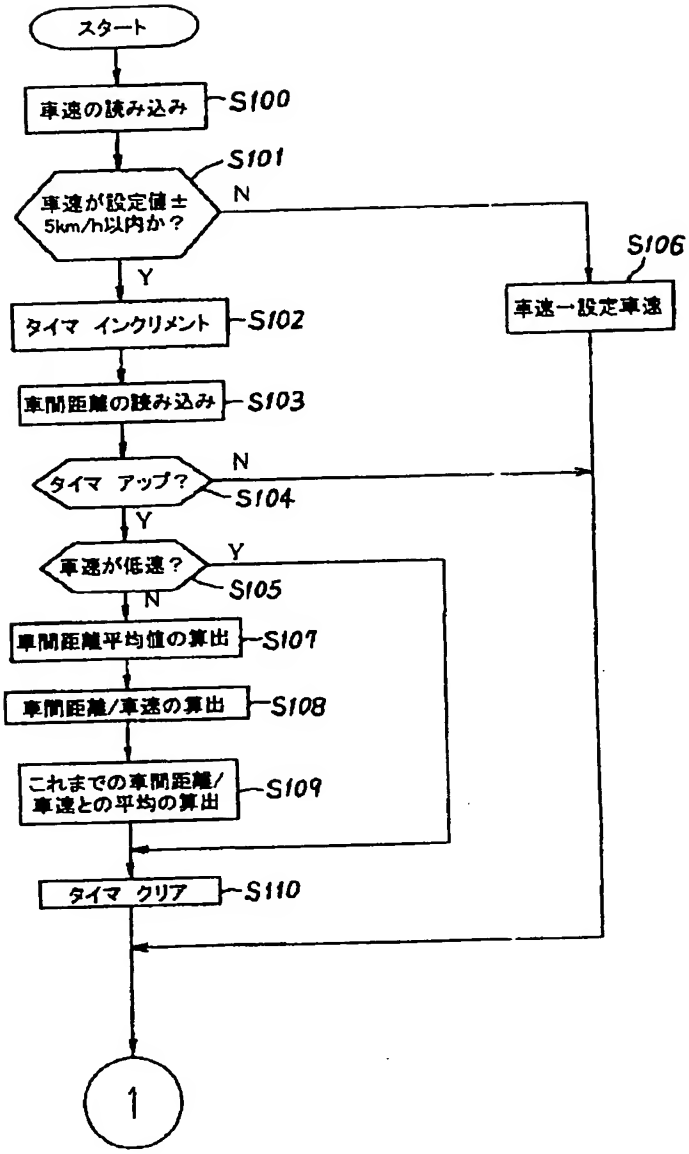
【図１】



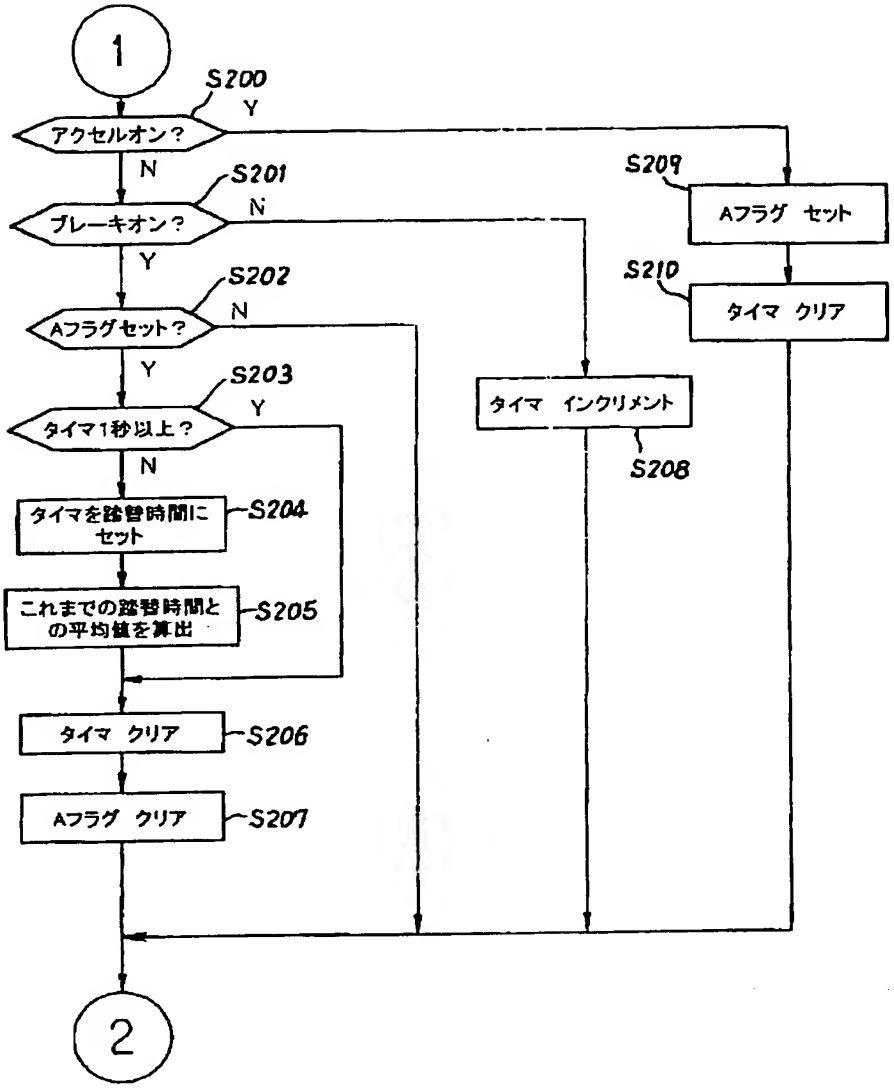

【図２】



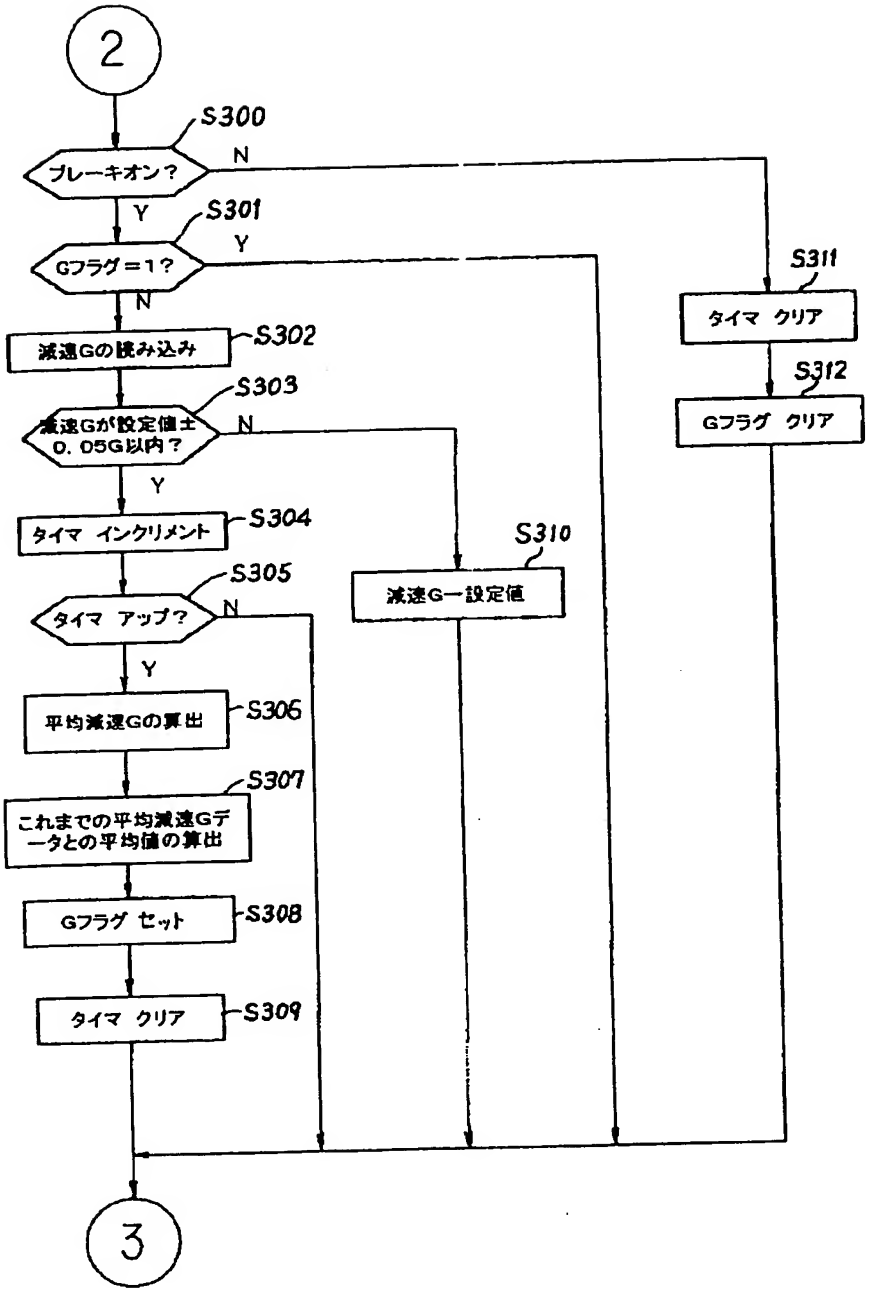
【図３】


スタート
車速の読み込み
S100
S101
車速が設定値±5km/h以内か？
N
Y
S106
車速一設定車速
タイマ インクリメント
S102
車間距離の読み込み
S103
タイマ アップ？
N
S104
Y
車速が低速？
Y
S105
N
車間距離平均値の算出
S107
車間距離/車速の算出
S108
これまでの車間距離/車速との平均の算出
S109
タイマ クリア
S110
1

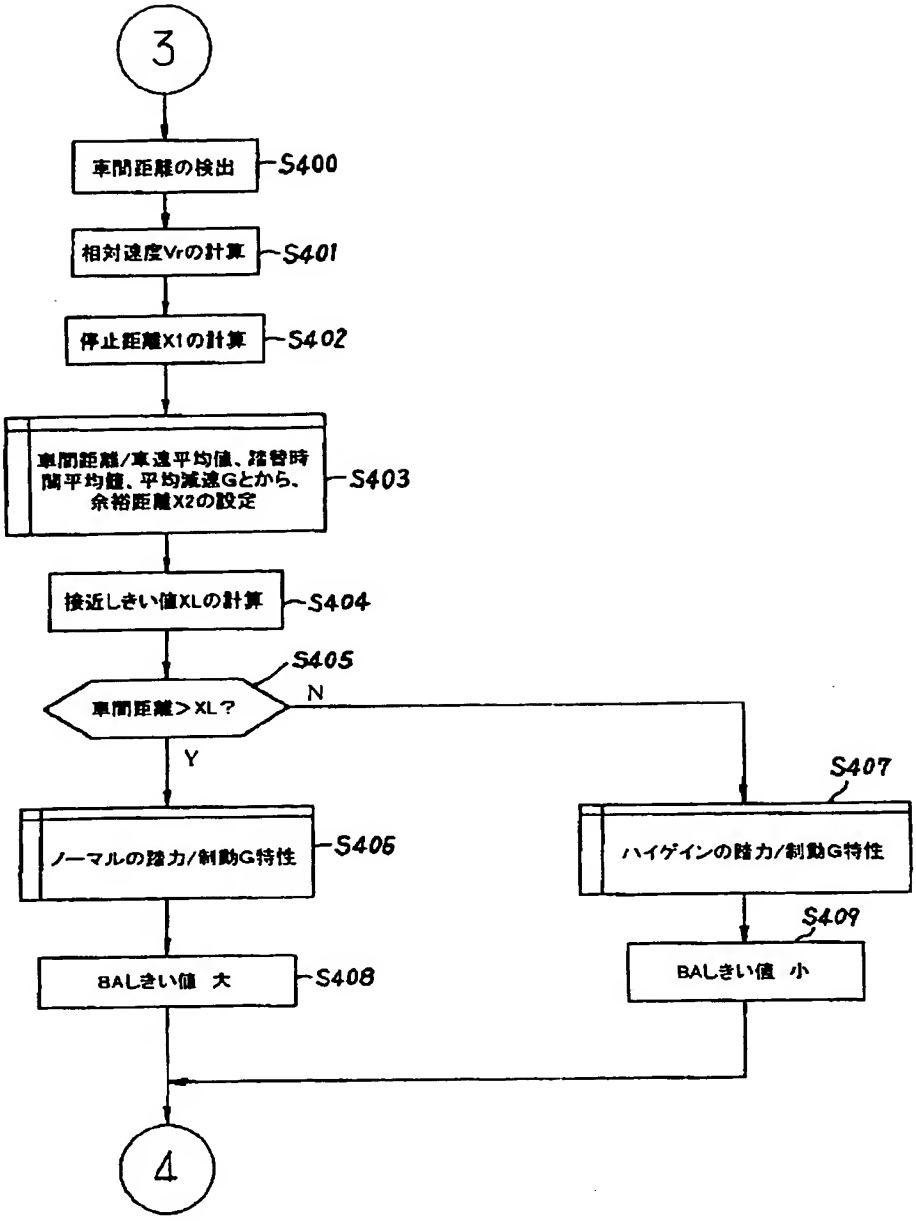
【図４】


1
S200
アクセルオン？
Y
N
S201
ブレーキオン？
N
Y
S202
Aフラグセット？
N
Y
S203
タイマ1秒以上？
Y
N
タイマを踏替時間にセット
S204
これまでの踏替時間との平均値を算出
S205
タイマ クリア
S206
Aフラグ クリア
S207
タイマ インクリメント
S208
S209
Aフラグ セット
S210
タイマ クリア
2

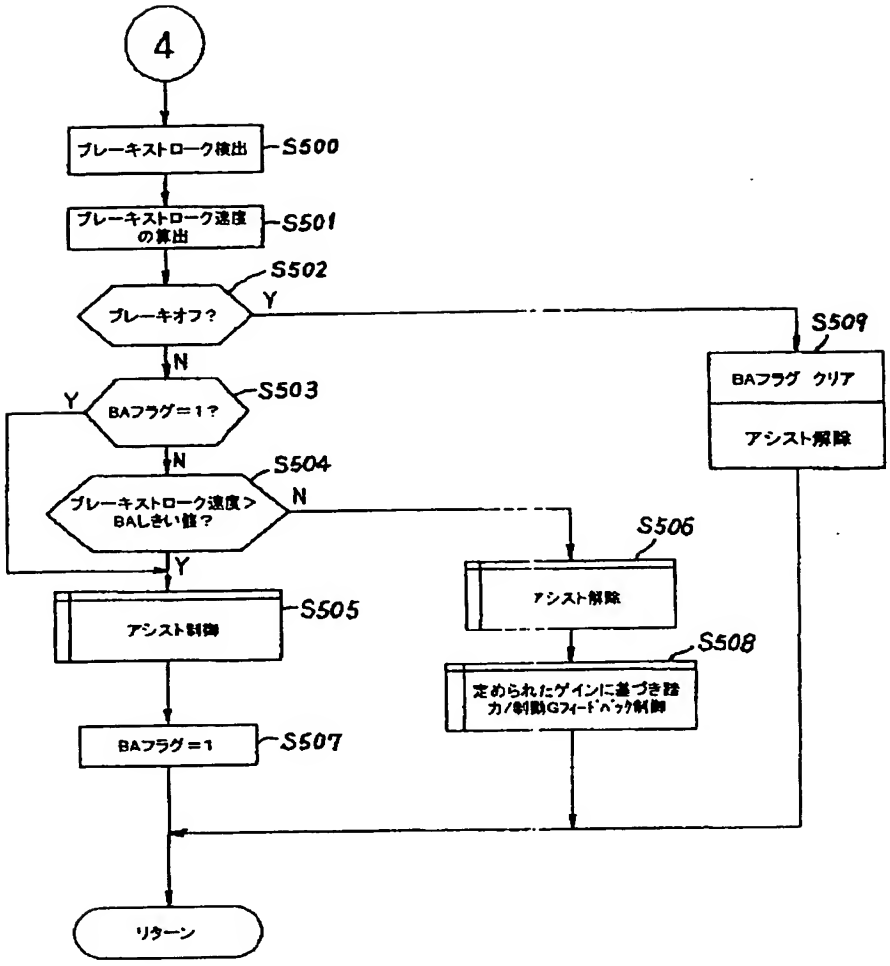
【図５】


2
S300
ブレーキオン？
N
Y
S301
Gフラグ＝１？
Y
N
減速Gの読み込み
S302
S303
減速Gが設定値±0.05G以内？
N
Y
タイマ インクリメント
S304
S305
タイマ アップ？
N
Y
平均減速Gの算出
S306
S307
これまでの平均減速Gデータとの平均値の算出
Gフラグ セット
S308
タイマ クリア
S309
S310
減速G一設定値
S311
タイマ クリア
S312
Gフラグ クリア
3

【図６】


3
車間距離の検出
S400
相対速度Vrの計算
S401
停止距離X1の計算
S402
車間距離/車速平均値、踏替時間平均値、平均減速Gとから、余裕距離X2の設定
S403
接近しきい値XLの計算
S404
S405
車間距離＞XL？
N
Y
S407
ノーマルの踏力/制動G特性
S406
ハイゲインの踏力/制動G特性
S409
BALしきい値　大
S408
BALしきい値　小
4

【図７】




【手続補正書】
【提出日】平成９年１１月１９日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】特許請求の範囲
【補正方法】変更
【補正内容】
【特許請求の範囲】
【請求項１】　自車両の前方検出物との距離を検出する手段と、
自車の車体速を検出する手段と、
該前方距離と該自車速とから相対速度を計算する手段と、
該相対速度から制動距離を計算する手段と、
該制動距離に対し加算する余裕距離を算出する手段と、
算出された制動距離と余裕距離との和をしきい値とする手段と、
現在の車間距離がしきい値よりも下回ったときに接近し過ぎると判断する手段と、
接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段とを有することを特徴とするブレーキアシストシステム。
【請求項２】　自車速から余裕距離を算出する場合において、運転者のペダル操作、制動減速度を含む車両情報、車間距離の取り方の一以上を監視することによって、当該運転者の特性に見合った車間距離のしきい値を設定する、ことを特徴とする請求項１記載のブレーキアシストシステム。
【請求項３】　請求項１、または請求項２において、アクセルペダルからブレーキペダルへの踏替時間の履歴

から、平均時間を算出する手段を含み、少なくとも該平均時間に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。

【請求項４】　請求項１、または請求項２において、車間距離の履歴から、車間距離平均値を算出する手段を含み、少なくとも該車間距離平均値に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。

【請求項５】　請求項１、または請求項２において、制動中の車両の前後減速度の履歴から、平均減速度を算出する手段を含み、少なくとも該平均減速度に応じて余裕時間を決定する、ことを特徴とするブレーキアシストシステム。

【請求項６】　請求項１、または請求項２において、アクセルペダルからブレーキペダルへの踏替時間の履歴から平均時間を算出する手段と、車間距離の履歴から車間距離平均値を算出する手段と、制動中の車両の前後減速度の履歴から平均減速度を算出する手段とを更に有し、

これら平均時間と車間距離平均値と平均減速度の３つの物理量の大きさに応じて余裕距離を決定する、ことを特徴とするブレーキアシストシステム。

【請求項７】　請求項６において、

車間距離平均値が大きく、かつ踏替時間平均値が大きく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも大きく設定する、ことを特徴とするブレーキアシストシステム。

【請求項８】　請求項６において、

車間距離平均値が大きく、かつ踏替時間平均値が大きく、かつ平均減速度が小さいときには、余裕距離の値は通常の値に設定する、ことを特徴とするブレーキアシストシステム。

【請求項９】　請求項６において、

車間距離平均値が大きく、かつ踏替時間平均値が小さく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも十分大きく設定する、ことを特徴とするブレーキアシストシステム。

【請求項１０】　請求項６において、

車間距離平均値が大きく、かつ踏替時間平均値が小さく、かつ平均減速度が小さいときには、余裕距離の値は通常よりも大きく設定する、ことを特徴とするブレーキアシストシステム。

【請求項１１】　請求項６において、

車間距離平均値が小さく、かつ踏替時間平均値が大きく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも小さく設定する、ことを特徴とするブレーキアシストシステム。

【請求項１２】　請求項６において、

車間距離平均値が小さく、かつ踏替時間平均値が大きく、かつ平均減速度が小さいときには、余裕距離の値は通常よりも十分小さく設定する、ことを特徴とするブレーキアシストシステム。

【請求項１３】　請求項６において、

車間距離平均値が小さく、かつ踏替時間平均値が小さく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも小さく設定する、ことを特徴とするブレーキアシストシステム。

【請求項１４】　請求項６において、

車間距離平均値が小さく、かつ踏替時間平均値が小さく、かつ平均減速度が小さいときには、余裕距離の値は通常の値に設定する、ことを特徴とするブレーキアシストシステム。

【請求項１５】　請求項３、請求項６、請求項７、請求項８、請求項９、請求項１０、請求項１１、請求項１２、請求項１３、または請求項１４のいずれかにおいて、

踏替時間が所定時間を超える履歴データは、平均時間の算出からは除外する、ことを特徴とするブレーキアシストシステム。

【請求項１６】　請求項１ないし請求項１５のいずれかにおいて、

所定車速以上の一定速走行時の車間距離の分布の状態から、余裕距離を決定する、ことを特徴とするブレーキアシストシステム。

【請求項１７】　請求項１６において、

車間距離の分布の代わりに、車間距離／車速、または車速／車間距離を用いる、ことを特徴とするブレーキアシストシステム。

【請求項１８】　請求項５、請求項６、請求項７、請求項８、請求項９、請求項１０、請求項１１、請求項１２、請求項１３、または請求項１４のいずれかにおいて、

ブレーキ踏み込み中の車両減速度が所定の範囲内にある時間が所定時間経過したときの車両減速度を、平均値の計算に用いる、ことを特徴とするブレーキアシストシステム。

【請求項１９】　請求項１ないし請求項１８のいずれかにおいて、

接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段は、運転者によるブレーキ入力に対する液圧ゲインを高くする、ことを特徴とするブレーキアシストシステム。

【請求項２０】　請求項１ないし請求項１８のいずれかにおいて、

運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、

接近し過ぎと判断されたときに、該しきい値の値を小さくする、ことを特徴とするブレーキアシストシステム。

【請求項２１】　請求項１ないし請求項１８のいずれかにおいて、
運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段を更に有し、
接近し過ぎと判断されたときに、付与する圧力の値を大きくする、ことを特徴とするブレーキアシストシステム。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】００１４
【補正方法】変更
【補正内容】
【００１４】また、車間距離平均値が大きく、かつ踏替時間平均値が大きく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも大きく設定する、ことを特徴とするものである。また、車間距離平均値が大きく、かつ踏替時間平均値が大きく、かつ平均減速度が小さいときには、余裕距離の値は通常の値に設定する、ことを特徴とするものである。また、車間距離平均値が大きく、かつ踏替時間平均値が小さく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも十分大きく設定する、ことを特徴とするものである。また、車間距離平均値が大きく、かつ踏替時間平均値が小さく、かつ平均減速度が小さいときには、余裕距離の値は通常よりも大きく設定する、ことを特徴とするものである。
【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】００１５
【補正方法】変更
【補正内容】
【００１５】また、車間距離平均値が小さく、かつ踏替時間平均値が大きく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも小さく設定する、ことを特徴とするものである。また、車間距離平均値が小さく、かつ踏替時間平均値が大きく、かつ平均減速度が小さいときには、余裕距離の値は通常よりも十分小さく設定する、ことを特徴とするものである。また、車間距離平均値が小さく、かつ踏替時間平均値が小さく、かつ平均減速度が大きいときには、余裕距離の値は通常よりも小さく設定する、ことを特徴とするものである。また、車間距離平均値が小さく、かつ踏替時間平均値が小さく、かつ平均減速度が小さいときには、余裕距離の値は通常の値に設定する、ことを特徴とするものである。
【手続補正４】
【補正対象書類名】明細書
【補正対象項目名】００２７
【補正方法】変更
【補正内容】
【００２７】また、踏替時間平均値、車間距離平均値、および平均減速度の物理量の大きさに応じて余裕距離を決定する場合において、請求項７ないし請求項１４記載の如く、その余裕距離の値を設定する態様で本発明は好適に実施できる。この場合は、このようにすることで、踏替時間平均値、車間距離平均値、平均減速度の３つの物理量の大小の組み合わせに応じたものとすることができる。したがって、例えば、かかる大小の組み合わせにより、運転者の特徴として最大８種のものに場合分けも可能で、それに合わせて、上記加算されるべき余裕距離の値を割り当てられる。好適実施例によると、余裕距離の値は、これを、例えば、より小さい値、小さい値、中程度の値、大きな値、より大きな値というように設定可能で、その分、きめ細かく設定を行うことができる。ここに、請求項７の場合は、運転者の特徴として、「安全志向、瞬発力高い、認知遅い」という特徴の場合、請求項８の場合は「安全志向、瞬発力高い、認知速い（熟練）」という特徴の場合、請求項９の場合は「安全志向、瞬発力低い、認知遅い（高齢・女性）」という特徴の場合、請求項１０の場合は「安全志向、瞬発力低い、認知速い」という特徴の場合のそれぞれの運転者に対して、効果的であり、また、請求項１１の場合は「接近派、瞬発力高い、認知遅い」という特徴の場合、請求項１２の場合は「接近派、瞬発力高い、認知速い（せっかち派）」という特徴の場合、請求項１３の場合は「接近派、瞬発力低い、認知速い」という特徴の場合、請求項１４の場合は「接近派、瞬発力低い、認知遅い」という特徴の場合のそれぞれの運転者に対して効果的である（後記表１）。もっとも、本発明は、このように段階的に余裕距離を設定する方法に限られるものではなく、例えばあらかじめ特性データを記憶させたテーブルやマップを用いて、これら３つの物理量を検索データとして、総合的な余裕距離の値を求める方法でも実施できるものである。
【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】００２８
【補正方法】変更
【補正内容】
【００２８】また、本発明は、アクセルペダルからブレーキペダルへの踏替時間の履歴からその平均時間を算出する場合において、請求項１５記載の如くに、踏替時間が所定時間を超える履歴データは、平均時間の算出からは除外する構成として、好適に実施できる。このようにすると、上記効果に加えて、たとえアクセルペダルを釈放しその後ブレーキペダルを踏み込むという一連のペダル操作が行われたにせよ、そのような所定時間を超える履歴データは踏替時間の平均時間の算出からは除外することができ、もっぱら踏替時間が所定時間を下回る場合の踏替時間情報を対象とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキ

アシスト制御の適正化を図ることができ、また、そのような踏替に要する時間が所定時間をも超えるようなアクセルペダルからブレーキペダルへの踏替の状態の時の踏替時間は履歴データとしても対象としないで済み、その踏替時間の履歴から得られる踏替時間平均値に応じて余裕距離を決定しようとする場合でも、その分、適用する踏替時間の履歴についても、より正確なものとなって、精度の向上が図れる。

【手続補正６】
【補正対象書類名】明細書
【補正対象項目名】００２９
【補正方法】変更
【補正内容】
【００２９】また、本発明においては、請求項１６記載のように、所定車速以上の一定速走行時の車間距離の分布の状態から、余裕距離を決定する構成とすることができる。このようにすると、上記効果に加えて、たとえ一定速走行時でも所定車速に満たないような低速走行状態で車間距離の情報を除外でき、もっぱら所定車速以上の一定速走行時の車間距離情報を対象とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキアシスト制御の適正化を図ることができる。また、そのような低速走行時の車間距離は履歴データとしても対象としないで済み、車間距離の履歴から得られる車間距離平均値に応じて余裕距離を決定しようとする場合でも、その分、適用する車間距離の履歴についても、より正確なものとなって、精度の向上が図れる。また、この場合において、請求項１７記載の如く、車間距離の分布の代わりに、車間距離／車速、または車速／車間距離を用いる構成としてもよく、同様にして上記のことを実現することができる。

【手続補正７】
【補正対象書類名】明細書
【補正対象項目名】００３０
【補正方法】変更
【補正内容】
【００３０】また、請求項１８記載の如くの構成として、本発明は好適に実施できる。このようにすると、上記効果に加えて、もっぱら、ブレーキ踏み込み中の車両減速度が所定の範囲内にある時間が所定時間経過したときの車両減速度を平均値の計算に用いることができ、それ以外は対象外とできて、余裕距離を定めるのに、より正確なものとなり、精度を高め得て本ブレーキアシスト制御の適正化を図ることができ、また、上記条件以外の場合の車両減速度は履歴データとしても対象としないで済み、制動中の車両の減速度の履歴から得られる平均減速度に応じて余裕距離を決定しようとする場合でも、その分、適用する車両減速度の履歴についても、より正確なものとなって、精度の向上が図れる。

【手続補正８】
【補正対象書類名】明細書
【補正対象項目名】００３１
【補正方法】変更
【補正内容】
【００３１】また、請求項１９記載の如くに、接近し過ぎと判断されたときに、運転者のブレーキ操作によって発生するブレーキ圧よりも高いブレーキ圧を付与するブレーキアシスト手段としては、これを、運転者によるブレーキ入力に対する液圧ゲインを高くする構成として好適に実施できる。この場合は、上記効果に加えて、ブレーキアシスト時、より迅速にブレーキ操作力を上回る制動液圧を立ち上げられて、アシスト圧を付与でき、適切にブレーキアシストに応えられ、この点で効果的なものとなり、本発明は、このような制御を加味して実施してもよい。

【手続補正９】
【補正対象書類名】明細書
【補正対象項目名】００３２
【補正方法】変更
【補正内容】
【００３２】また、請求項２０記載の如くに、運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段をもち、接近し過ぎと判断されたときに、該しきい値の値を小さくする態様の構成として、実施できる。この場合は、運転者のブレーキ入力速度に対する比較用のしきい値をも設けて、検出されるブレーキ入力速度とこれとを比較することで、その入力速度が該しきい値よりも上回ったときに所定の圧力を付与するようブレーキアシストをする方式の場合に好適に適用でき、車間距離が接近し過ぎと判断されるのに連動し、それに合わせて、当該比較用のしきい値を小さくして、その検出ブレーキ入力速度との判定が行えることとなり、上記のようなブレーキアシスト方式のときは、本発明は、このような制御をも加味して実施することができる。あるいはまた、請求項２１記載の如くに、同様に、運転者のブレーキ入力速度を検出し、入力速度がしきい値よりも上回ったときに所定の圧力を付与する手段をもち、車間距離が接近し過ぎと判断されたときに、付与する圧力の値を大きくする態様の構成としてもよい。この場合も、上記のブレーキアシスト方式に適用して、本発明は好適に実施することができる。